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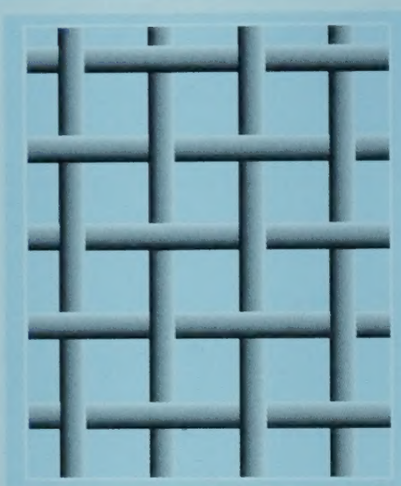

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FISHING CHIMES

2001 in Retrospect

Developments, Lessons and Events

The year 2001 rolled out, leaving in its wake considerable disenchantment among various fishery industries, be they related to capture and culture fishing effort, processing, or exports. All these sectors sustained a setback during the year. On the marine capture side, the coastal fishing as well as the offshore/deepsea fishing sectors suffered serious losses, partly due to failure of prime shrimp fishing season (mostly because of late onset of breeding and consequent reduction in sizes at capture) and partly because of a major decline in shrimp export prices (because of heavy stock holding, particularly in Japan, and also because of lower count problems) for a good part of the season. The shrimp culture fishery sector also had its alarming share of disappointment and suffering, as the export prices of cultured shrimps too declined because of buyer resistance. Added to this, the shrimp culture sector had the misfortune of the white spot virus disease (WSSV) attack, mostly because of heavy rains and sudden fall in water temperature during the two main culture seasons. Another debacle was that flood waters engulfed shrimp farms, particularly along the east coast, taking the farmers unawares and unprepared, resulting in loss of crops. This setback had also burdened the farmers with additional investments for the following crop. As the policy of insurance companies was not to insure shrimp/fish crops, farmers had to mobilise needed funds etc., on their own, mostly depending heavily on processors/exporters, as the banking sector, by and large, was averse to extend financial assistance to farmers.

The freshwater culture sector, which is mostly related to major carps, also had to endure severe problems in raising crops, for the same reason, as in the caseof shrimp crops. So much so, fish exports from A.P. to North-eastern States suffered a setback.

There were agitations by the mechanised boat operators at several places along the coastline, seeking subsidy towards spiralling fuel costs and relief from relentless operations of a large number of foreign fishing vessels in Indian EEZ and that too often close to the coast. Their grievance was that these foreign fishing vessels had been cornering the resources that rightfully belonged to them and this had led to fall in their catches and earnings thereof, which as it turned out, were not even adequate to meet their vessel running and maintenance expenses. The same problem was faced by the larger fishing vessels too.

Unable to withstand the fall in catches and earnings thereof, a company owning six trawlers managed to shift them for fishing in the EEZ of Indonesia. Around another ten trawlers also shifted operations to fishing grounds in the Indian EEZ around Andaman and Nicobar Islands. The unfavourable situation has also led to a selling spree of quite a few trawlers, but, fortunately, all of them changed hands at the same base only and continued operations. The swapping activity was confined mostly by way of sales to captains of fishing vessels. Another noticeable development was that the strength of larger fishing vessel fleet had dwindled down to around 70 nos over the post few years from a fleet strength of over 190 vessels. Reduction in fishing effort however took place as some of the companies sold their trawlers to foreign enterprises, and some became defunct.

The Government of India relaxed regulations in respect of importing fishing vessels by Indian enterprises. As a result, several Indian companies, most of whom were earlier in the business of 'operating' foreign vessels on charter, purchased a good number of trawlers as well as tuna longliners and registered them as Indian vessels. In a way, this has been a good development in that these initiatives increased the strength of Indian fishing fleet, despite a belief nurtured by several that these vessels continue to be owned by the foreign enterprises concerned, and the device of Indian ownership has enable them to legally gain access to Indian EEZ. This interpretation would not however have any force, as long as our government has no policy (in respect of financing etc.) to enable Indian entrepreneurs to acquire vessels under their real ownership. The consoling point is that something is better than nothing, although this consolation is shameful to India, a South Asian Power. It is stated that these vessels are being operated by foreign crew under an arrangement for export of the catches to the erstwhile foreign owners. A good number of these trawlers chose to operate them in the area of operation of other Indian owned trawlers, thereby creating fishing competition and sharing of stocks. This situation has created a problem to the government as well as the fishing industry. There was a litigation initiated by one or two or more

☞

out of those who acquired vessels undo the new regulations, when the operations were interfered with by the coast guard but the situation appears to be returning to normalcy.

Indian Marine Products Exports are reported have received some setback in the sense that the anticipated increase in culture shrimp exports is believed to be of an order adequate just to compensate the visualised drop in exports because of expected cumulative fall in capture shrimp catches. In any case, the outlook is that the marine products exports during 2001-2002 may either reach the level achieved in the previous year, or marginally exceed it. It may be mentioned here that during the year 2000-2001, marine products exports grew by 23.3%, touching a level of Rs. 6,300 crores.

Most of the processing plants in the country could secure the approval of EU for exports to EU countries. Another development is that there have been initiatives to process and export value-added products, encouraged by several subsidies instituted by MPEDA to promote value addition to exported products.

The Aquaculture Authority of India, supported by MPEDA and Coastal State/UT Governments, could motivate farmers engaged in shrimp aquaculture in Coastal Regulation Zone (CRZ) to register themselves with the Authority. This has given fillip to a trend directed at regulating and accounting for aquaculture units in operation in the coastal regulation zone as per the norms laid down by the Supreme Court in its September 2001 judgement. Another development is that, at the instance of the Supreme Court of India, the Aquaculture Authority has submitted to the Court a comprehensive report on the present status of aquaculture in the CRZ, highlighting the fact that culture activities in the zone are being in the nature of traditional and modified traditional operations and also stating that there has been practically no adverse impact on the environment. In order to tackle the problems of incidence of white spot virus and other diseases, particularly in the coastal aquaculture sector, MPEDA has set up several PCR laboratories in all the Coastal States where there is concentration of the activity. This facility has come as a boon to farmers. Over and above this, MPEDA announced several subsidy schemes, one of which was to help private sector hatcheries, by way of handsome subsidies, in the setting up dedicated PCR laboratories at their hatcheries.

The Central Institute of Fisheries Education has set up a research laboratory in Udaipur, Rajasthan to undertake investigations on fish production using underground saline water available in the arid agro climatic region of the State.

CMFRI has made considerable progress in the production of domesticated brooder/gravid tiger shrimp. The work is stated to be now in the stage of production of fourth generation (F_4) of progeny. Efforts are understood to be on to secure the needed funds to step up the pace of the ongoing work. The development of domesticated brood shrimps will go a long way in eliminating WSSV among cultured shrimps.

The marine fishery potential of the Indian EEZ has been revalidated by a Group of Scientists set up by the Government. The report submitted by the Group is understood to have indicated that there is practically no change in resources position.

Ms. Nirja Rajkumar, Joint Secretary, Fisheries, in the Union Department of Animal Husbandry and Dairying, has been re-elected as Co-Chairman of the Indian Ocean Tuna Commission. Shortly after this election, however, Mr. P.K.Pattanaik, has taken over as Joint Secretary, (Fisheries). Similar undesirable development struck the industry earlier, when Ms.Nita Chowdhury, the then Joint Secretary, (Fisheries), was the Co-Chairman of IOTC. She was transferred, unfortunately though, at a time when she was revitalising the developmental activities in a focal manner, particularly in respect of tuna fishery development of Indian EEZ. Nevertheless, the choosing of an Indian for the Co-Chairmanship has highlighted the important position India holds in the tuna arena. Some work has been done by MPEDA during the year for the introduction of a Pilot Tuna Project involving the installation of tuna longlining equipment on two shrimp trawlers in the commercial sector, to undertake tuna operations in the Indian EEZ, the work to be entrusted to a Japanese Company. While it may take some more time for the maturation of the project, in the meanwhile, it has so happened that, as the year was drawing to a close, a good number of trawlers, having come across sizeable shoals of big eye and yellowfin tuna in the Upper Bay of Bengal, operated handlines and, in a few days, each of the vessels could catch around 3 to 5 tonnes of these fishes, each weighing around 4-5 kg. This incident lends proof to the tuna potential that Bay of Bengal holds. In fact, it is observed by several that one reason for the convergence of several foreign tuna vessels into the eastern belt of Indian EEZ is the tuna potential it commands.

The Government of India declared 10th July as Special Fish Farmers' Day. The importance of this day leading to such a declaration is that on 10th July 1957, Dr. Hiralal Chaudhuri, achieved a breakthrough in inducing major carps to breed, through administration of pituitary hormone injections. The event took place at Angul in Orissa. Hiralal Chaudhuri Best Farmer's Gold Medal, instituted by Fishing Chimes Jayasree Charitable Trust, 2001 was awarded, on the occasion of the celebration of the Day on 10th July 2001 at the Central Institute of Fisheries Education, Mumbai, to Mr.C.Srikanth, a progressive fish farmer, for his remarkable achievement in hatchery production of freshwater prawn seed and also a high level of giant freshwater prawn culture production.

Tenth plan fisheries schemes have been finalised during the year. The accent of these schemes is stated to be on augmenting and extending inland culture fish production, particularly in the coldwater belt of the country. The reason for this slant is that the development of coldwater fisheries of the country could not progress all along at the same pace as

in the warm water States of the country. An exception to this probably is that trout culture fishery development has received a remarkable fillip in the State of Himachal Pradesh, in the recent years. The Norwegian Government extended technical and financial assistance in this regard to the State, besides assistance for the setting up of a trout hatchery. Well designed steps have been taken in the State to popularise trout culture activity among the emerging trout farmers.

Another achievement in the year 2001 was the consolidation of the technology of shrimp culture in freshwater ponds. The related technology, innovated by the farmers themselves, has become fairly well established in the inland areas adjacent to the east coast, but away from it, particularly in the central zone. The shrimps grown in freshwater now stand accepted in Japan and other importing countries.

There have been cognisable efforts on the part of several coastal fish farmers to diversify efforts towards culture of species other than shrimp, particularly for the reason that shrimp is vulnerable to disease. The main alternative species favoured by most of the farmers is Seabass, culture technology of which has been standardised by the Central Institute of Brakishwater Aquaculture.

There has been focal patronage extended by the farmers in respect of production of the giant freshwater prawn seed and also culture of the prawn. This activity has spread not only in the inland cultivable waters adjacent to the coastal zone but has also moved farther into inland areas in Madhya Pradesh, Maharashtra and so on. Polyculture of major carps with prawns/shrimps has started gaining favour among aquafarmers. Further, there are several who are contemplating to secure government's approval for the culture of monosex Nile Tilapia/GIFT for the reason that the fish has a wide market in the form of fillets in USA and in several European countries. In several south east Asian countries, culture of this fish has become popular, for the reason that it is eco-firendly with practically no negative effects on the environment. There is a global view that asserts its positive qualities particularly in respect of eco-friendliness. Monosex culture is undertaken in these countries only as a measure of abundant caution. A trend towards setting up of aquaculture clubs and clinics , particularly in the State Andhra Pradesh, has set in.

*The Asian catfish, **Clarias gariepinus**, which strayed into Indian inland waters from Bangladesh, has spread into almost all the States of the country, despite the ban imposed by the authorities on its introduction.*

Fish production from Govind Sagar reservoir crossed a record level of production of 900 tonnes by mid Jan. 2002 and may cross 1200 tonnes level by March 2002.

Tawa Resevoir in Madhya Pradesh yielded for the first time 327 t of fish in 2000-01 under the management of Tawa Matsya Sangh.

Santha Marine Bio-technologies Pvt. Ltd., Hyderabad added during the year a Rs.ten crore marine algae culture facility for the production of Vitamin A. The plant is located at Kalla Mozhi village near Tiruchandur in Tamilnadu.A multifilament fishing net plant, set up by Safa Marines Ltd., Bhubaneswar, was inaugurated during the year by Norwegian Ambassador in India, at Balasore, Orissa. This company has also introduced a new 23 m LoA, trawler 'Sai Sadoba' with Haldia in West Bengal as the base.

*A breakthrough in the larval and post-larval production of the Ganga river prawn, **Macrobrachium birmanicum choprai**, has been achieved at the Central Institute of Freshwater Aquaculture.*

The Central Institute of Brackishwater Aquaculture, Chennai, shifted into its own building during the year. The regional centres of Central Marine Fisheries Research Institute and the Central Institute of Fisheries Technology came into being in Visakhapatnam during the year, through upgradation of their earlier sub-centres at the place. The Fishery Survey of India, has taken up the construction of its research centre in Mumbai. CICFRI's North-eastern Regional Centre was inaugurated at Dispur, Guwahati on 6 November 2001.

The Department of Fisheries, Kerala, has initiated a housing and colonisation scheme for its fishermen. Kerala State has also pioneered in entrusting fishery development work to panchayats under a local self government set-up, through a project known as Janakeeya Matsya Krishi. The government of Madhya Pradesh has decentralised the administrative powers related to fisheries development to the District level officers. CIBA developed shrimp feed technology for processing and production of different grades of pelleted feeds for use in improved extensive and semi-intensive culture of tiger as well as Indian white shrimps. Private sector feed manufacturing companies such as CP Aquaculture, Higashimaru, Gold Mohur, Avanti Feeds etc., have stepped up their role in supplying quality feeds to the farmers. Godrej Agrovet Ltd., set up a sophisticated Aquafeed Plant in Association with Tai Aqua Company, Taiwan, at Chennai. Santir Aquatic Pvt. Ltd. set up a captive PCR Laboratory at its hatchery located near Kakinada in A.P. Several other hatcheries also set up such PCR Laboratories at their hatcheries. A PCR lab was also set up by the A.P. State Fisheries Department in collaboration with the State Institute of Fisheries Technology, Kakinada.

The Ministry of Health and Family Welfare issued the final notification dated 2 May 2001 laying down doses of irradiation in respect of fresh sea foods, frozen sea foods and dried sea foods.

Indian Culture Shrimp Production crossed 100,000 t mark per annum. Among all the States engaged in this activity, A.P. emerged as the top most with 74,000 ha brought under shrimp culture, producing nearly 45,000 t of shrimp.

*The endangered turtle, **Kuchuga sylhetensis** has been located for the first time in Cooch Bihar District of West Bengal.*

CMFRI could secure an order for setting up a Marine Pearl

Nuclear Implantation Unit at Sharjah, UAE.

A Model Marine Plywood Fishing Boat specially designed for A.P. fishermen and constructed by South Indian Federation of Fishermen's Societies, Trivandrum was launched by Prof. K.V. Thomas, Kerala Fisheries Minister during the year.

Ornamental fish production, mostly for export, has made new strides. High levels of production have been achieved in Tamilnadu and West Bengal. The activity is being pursued as a cottage industry, particularly in South 24 Paraganas District of West Bengal.

There are indications that the Government as well as the industry may have a few lessons to take, as reflected by the experiences gained in the process of implementation of fisheries development programmes in the country during the year. An effort is made hereunder to put them together: There has been a persistant demand from various fisheries associations for the past several years for the creation of separate Union Fisheries Ministry or atleast a separate Union Department of Fisheries. There have been also any number of recommendations in this regard made at several conferences, seminars and symposia. The subject of fisheries, with enormous potential to contribute to nutritional security of the country and to augment export earnings from the sector substantially (from the present annual level of Rs.6,300 crores), certainly deserves serious consideration of the government. A general grievance is that ignoring level of export earnings from fisheries sector which are more compared to Animal Husbandry and Dairying sectors, that the fisheries sector has also the potential to contribute to the nutritional security of the nation, and that it deserves and needs a fillip to play its due role and also highlighting the same, the benign government has been complacent about this vital need. This neglect is on a flimsy and untenable ground that the fisheries sector has not generated sufficient work for the government. One expects that government would have the general perception that, when only it gives fillip to a potential activity such as fisheries development, there will be generation of work, that will be productive too and contribute to national economy in a greater measure. We have to expect the Union Agriculture Minister to bestow his attention on this aspect from this perspective.

The main marine resource that now stands virtually unexploited is tuna. The government cannot really have any excuse for dabbling with this issue any more, particularly when India holds the Co-Chairmanshimp of Indian Ocean Tuna Commission. There is a strong view that government should launch a major project as a joint venture with a country having good reputation and without undue selfish motives in respect of the integrated development of tuna fisheries of Indian EEZ. The moves of certain countries trying to gain access into Indian EEZ through devious means to achieve their commercial objectives need to be check-mated through formation of joint ventures direct with friendly countries having known expertise in monofilament longlining, which is required to be developed in India on top priority to stem the incursion of poaching foreign vessels through irregular routes.

Several countries who export sashimi tuna to Japan have developed not only landing and berthing facilities for their tuna vessels, but also facilities for airlifting the catches to Japanese market by small planes within a short time of arrival of vessels at port. One reason for the checkered tuna fishing effort in Indian EEZ by genuine Indian Vessels is the absence of facilities and funds. Entrepreneurs have been for long voicing the cruciality of setting up such facilities, at a location in Andamans (Andamans happens to be a crucially central location for tuna fishing, as evidenced by not only the locational aspect, but also the convergence of several foreign vessels to fish in the area, braving risks of apprehension), and at selected ports on the mainland, atleast one on the east coast and one on the west coast. Learning a lesson from the present state of affairs, government should take steps to introduce an integrated project as a joint venture from the stage of infrastructure development suited for airlifting of chilled sashimi tuna to Japan for marketing, with linkages for the introduction of an integrated tuna fishery programme in collaboration with a country such as USA or Australia or New Zealand, providing for transfer of technical expertise. It is widely known that a Tuna Project of this kind has special significance of being a substantial foreign exchange earner.

The Indian exports of shrimp take place largely in block-frozen form. It is common knowledge that importers utilise block-frozen shrimp for re-export in value-added form. A lesson has already been learnt that value-added shrimp products have to be exported in the place of block-frozen product for higher earnings, but progress in regard to the swiching over to value-added system is very slow, despite introduction of schemes by MPEDA for providing incentives by way of subsidies for installation of the needed equipment at the processing plants and for adopting improved packing systems conforming to international standards. Greater attention is needed to hasten the switching over process.

There has been a long standing proposition for encouraging diversified culture for the production of species suitable for both export and domestic consumption through development of coastal wastelands, and fallow saline stretches in Haryana, Rajasthan, Punjab and Western Uttar Pradesh. The initiative stated to have been taken by ICAR for a survey in this regard with Australian co-operation is timely and it deserves to be pursued to its logical end.

The fall in export prices of certain marine products has left the industry high and dry with no alternative in sight. This emphasises the need for development of a strong nation-wide domesticated marketing network to act as a deterrent to reduction in export prices by the importing countries, and as a mechanism for providing fish supplies to the Indian population in an enduring manner at reasonable and stable prices. An efficient domestic marketing system will act as a signal to importers that regulation of export prices as they now do cannot be the same when India has a domestic fish marketing network supported by a cold chain.

It is good that efforts are on for production of tiger shrimp

brooders through a domestication programme. This process has to be stepped up for achieving results in the shortest possible time. While India may not need foreign collaboration in this regard, the present need, however, is for funds and facilities. ICAR should not have much of a problem in this regard, considering the crucial importance of development of domesticated tiger shrimp brooders. Until such time a breakthrough in.this regard is achieved, shrimp hatcheries would have no alternative other than dependence on wild brooders. The continuance of this dependence would only mean the prolongation of the the present menace of outbreak of white spot virus disease attacks among cultured shrimp, with all the attendent problems of economic losses to farmers and fall in export earnings.

Seminars, Workshops, Conferences, Symposia

A National Symposium on 'Fishery Technologies and their Commercialisation' was held at CIFE, Mumbai on 11 and & 12 January 2001.

A National Workshop cum Training programme on 'Bioinformatics and Aquaculture research' was held at CIFA from 16 to 19 January 2001.

A Fish Farmers Meet on 'Jayanti: Improved Rohu' was held at CIFA, Bhubaneswar on 29 & 30 January 2001.

A Special Training Programme for fisherwomen of Versova village was held at CIFE, Mumbai from 22 to 27 January 2001.

The 13th biennial Seafood Trade Fair of Indian Seafood Industry was conducted by MPEDA and SEAI from 9 to 11 February 2001 at Visakhapatnam.

The Lucknow Centre of CIFE, organised a short term training programme on 'Aquaculture and Trade' from 11 to 17 February 2001.

Tamil Nadu State Fisheries Department organised a Training Programme on Shrimp Disease Diagnosis at Tuticorin from 12 to 14 February 2001.

A National Workshop on Monitoring, Control and Surveillance of Fisheries was held at Goa by FSI from 12 to 16 February 2001.

A Seminar on shrimp culture under the auspices of AP Shrimp Farmers Action Committee was held at Bhimavaram, Andhra Pradesh on 26th February 2001.

A one day Farmers Meet on 'Eco-friendly and Sustainable Fresh Water Prawn Culture' was held at Sambalpur, Orissa on March 2001.

A Seminar on 'Present Status and Future Challenges to Inland Aquaculture in Karnataka in the New Millennium' was held by Karnataka Fisheries Department at Bangalore on 2 and 3 March 2001.

A Workshop on 'Fish Loss Assessment and Control' was held at CIFT, Kochi from 6 to 8 March 2001.

A two day Workshop on 'Aquaculture Diversification in India' was conducted at Andhra University by its Marine Living Resources Department on 23 and 24 March 2001.

A Training Programme on 'Health Management in Shrimp Culture' was held at Andhra University by its Marine Living Resources Department from 26 to 29 March 2001.

Inter-regional Workshop on 'Techno-economic Performance of Marine Capture Fisheries and the Role of Incentives, Value Addition and Changes of Fleet Structure' was held at BIRD, Lucknow from 2 to 6 April 2001.

A Training Programme in 'Breeding and Culture of Catfishes of India' was held at Agartala on 25 and 26 April 2001.

The Fourth Annual Exhibition of Ornamental Fishes was held at Bangalore from 18 to 22 May 2001.

A National Seminar on 'Riverine and Reservoir Fisheries: Challenges and strategies' was conducted by CIFT at Kochi on 23 and 24 May 2001.

A Seminar on 'Sustainable Shrimp and Prawn Culture' in Orissa was held at Bhubaneswar on 29 May 2001.

Gold Mohur Foods and Feeds Ltd. conducted a Seminar on 'Hanaqua Shrimp feed' at Ongole, A.P. on 22 June 2001.

Shrimp Hatchery Operators and Shrimp Farmers' Meet was conducted by MPEDA at Kakinada, A.P., on 26 June 2001.

An Indo-UK Workshop entitled 'Need Based Professional Education and HRD in Fisheries' was held at College of Fisheries, Mangalore on 30 June 2001.

An International Workshop on 'Aquaculture and Environment' was held at CIFT, Cochin on 13 and 14 of July 2001.

Special Fish Farmers Day was celebrated on 10 July 2001 all over the country. Fishing Chimes Jayasree Charitable Trust's Hiralal Chaudhuri Best Fish Farmers Gold Medal was awarded on this day to Mr.C.Srikanth by Mr.Nitish Kumar, Union Agriculture Minister on the occassion of the celebration of the event at CIFE, Mumbai on 10 July 2001.

A Training programme on 'Eco-friendly and Sustainable Freshwater Prawn farming' was conducted by A.P. Fisheries Department at Hyderabad from 23 to 27 July 2001.

A two day Indian Ocean ARGO Implementation Planning Meeting was held in Hyderabad on 26 and 27 July 2001.

A Farmers' Meet on 'Eco-friendly and Sustainable Shrimp Farming' was held at Karlapalem, A.P. by MPEDA on 11 August 2001.

A National Workshop on 'Mighty Mahseer' was held at Lonavala by Tata Power Company Ltd., Indian Fisheries Association, Asian Fisheries Society Indian Branch and CIFE on 24 and 25 August 2001.

A Conference on 'Impact of WTO provisions on Fisheries

Sector' was held by A.P. Fisheries Department at Visakhapatnam on 12th September 2001.

A Joint Business-cum-Operators Meet was organised at Veraval by Gujarat's Apex Fisheries Cooperative along with Messrs. Ashok Leyland, on 14 September 2001.

The Fourth World Conference on Shrimp Industry and Trade, (SHRIMP 2001), was held at Chennai by INFOFISH, in association with MPEDA and others from 27 to 29 September 2001.

A Training programme on 'Potential of Artificial Substrate based Microbial Film in Aquaculture' sponsored by UNESCO was held at College of fisheries, Mangalore on 15 and 16 October 2001.

A National Workshop on 'Sustainable Participatory Development and People's Management of Natural Resources' was conducted by Tawa Matsya Sangh at Kesla, Hoshangabad on 1 and 2 November 2001.

A Regional Consultation on 'Research Needs for Development in the North East' was conducted by CICFRI on 6 and 7 November 2001. .

Workshop on 'National Bio-diversity Action Plan conductedd at SIFT Kakinada, A.P. on 16 November 2001.

A Seminar on 'Science and Technology, Coastal Zone Management and Policy' was organised at College of Fisheries, Mangalore on 17 and 18 November 2001.

First International Conference on Women in Fisheries was held by the Indian Forum of Fisheries Professionals at CIFE, Mumbai on 8 and 9 December 2001.

An International Symposium on 'Fish for Nutritional Security in 21st Century' was held at CIFE from 4 to 6 December 2001.

(The editor will appreciate being favoured with particulars of any of the events inadvertantly left out , for publication in the next issue of F.C.)

Fisheries Education and Training Events

The West Bengal University of Animal and Fishery Sciences started MFSc Course in Fishery extension.

A Short Course on Digital Imaging and Graphics was organised by CIFE, Mumbai from 26 February to 3 March 2001.

NBFGR Lucknow conducted a Training Course on Molecular Markers as Tools for Fish Population Genetic Analysis from 29 October to 10 November 2001.

CIBA released CD-ROMs on Proceedings of National Workshop on Bioinformatics and Statistics in Aquaculture Research and Fish Disease Database Information System on 16th January 2001.

A Summer School on Culture Based Fisheries for Inland Fisheries Development was conducted at CICFRI from 18 July to 17 August 2001.

'Short Course on Applied Nutrion in Freshwater Aquaculture was held at CIFA from 13 to 22 December 2001.

Andhra University has recognised FSI, Mumbai and Visakhapatnam as centres of research.

The following books were released by Mr.Nirja Rajkumar on 27 November 2001: Fish biology and Fish Handling by Dr.S.Bijoy Nandan; Meteorology by Dr.Jomon Joseph; Elementary Marine Engineering for MFV course by C.Rethinadas; Practical Navigation for MFV course by K.C.Udayaprakasan; Basic Electronics and Fish finding equipments for MFV course/EDFV course by C.D.Joshy and M.Devadhason; Chart work for MFV course by M.P.Mohan and Hindi version of the book on Fish Biology by S.Bijoy Nandan .

Books Reviewed by Fishing Chimes: *1) Planning of Fisheries Harbours in the Indian Context: Author ~ C.T.Betgeri.*

2) Statistical Techniques in Microbiology: Author ~ K.S.Udupa.

3)Sewage Fed Aquaculture: Author ~N.M. Chakrabarthy.

Appointments

Mr. R. Ganapathy, assumed charge as Director, MPEDA, Kochi.

Mr. D.V.Prasad, IAS, has taken over as Director (Marketing), MPEDA, Kochi.

Dr. G. Santhanakrishnan, took over as Secretary, MPEDA, Kochi.

Mr. Gagankumar Dhal, IAS, took over as Director of Fisheries, Orissa.

Mr. Sampath Kumar, IAS, took over as Commissioner and Director of fisheries, Tamilnadu.

Dr. Y.S.Yadava, IGO Co-ordinator BOBP takes charge as Member Secretary of Aquaculture Authority.

Ms. Nirja Rajkumar, IAS, took over as Joint Secretary (Fisheries), but later replaced by Mr.P.K.Patnaik, IAS.

Dr. Dhurendra Kapoor, took over as Director, NBFGR, Lucknow

Dr. K. Janakiram, took over as Director, CIFA, Bhubaneswar.

Dr. V.V.Sugunan, took over as Director, CICFRI, Barrackpore.

Mr. Ashwini Kumar Pradhan, IAS, joined as Additional Chief Secretary for Ports and Fisheries, Govt. of Gujarat.

Awards

14th Khwarizmi International Award was conferred on Dr.K.Gopakumar, Deputy Director General (Fisheries), ICAR for his outstanding achievements and contributions to fisheries science and technology.

The National Award for Womens' Empowerment, 2001 was conferred on Dr. Krishna Srinath, CIFT, Kochi.

Annual Awards 2001 of Fisheries Technocrats Forum, Chennai were conferred on Dr. V.V.Sugunan and Dr. E.Vivekanandan.

ICAR's 'Sardar Patel outstanding ICAR Institution Award' for 2000 was bagged by CIFT, Kochi.

Hiralal Chaudhuri Gold Medal 2001 was conferred on Mr. Ch. Srikanth.

Mr. Sunit Kumar Singh, NBFGR bagged "Skinner Memorial Award" and "Travel Award".

Dr. K.J. Rao, Director, CIFA was conferred with Rafi Ahmed Kidwai Award for the biennium 1999-2000.

Swami Sahajanand Saraswathi Extension Scientist/worker Award was conferred on Dr.J.C.Markanday NDRI, Karnal.

Dr. S.Z.Qasim Gold Medal (2000) was conferred on Dr.K.Pani Prasad.

Dr. K.V. Rajendran bagged the best poster presentation award at the 10th International Conference of the European Association of Fish Pathologists.

Dr. K.V.Devaraj, was the recipient of fellowships of the National Academy of Agricultural Sciences and Indian Fisheries Association.

At a function held at Kochi on 27 November 2001 for the award of D.A.S Gnanadoss medal, . the following awards were conferred by Joint Secretary (Fisheries), Ms.Neerja Rajkumar: Best trainee of MFV course to Sayooj Joseph, P.J. Vipin Joseph Vacco and Akash. R; and Dr.C.P.Verghese Medals for EDFV course to Dilip kumar, Senthil Kumar and T.V.Sajeev.

Life Time Achievement Awards were conferred by the Association of Indian Fisheries Industries on Messers J.V.H.Dixitulu, N.S.H.Prasad and Dr.C.Babu Rao.

A.P. Government's best exporter award for 1999-2000 was conferred on Nekkanti Sea Food Limited, Visakhapatnam.

The following of the fisheries sector left the Mortal World during the year

Dr. V.K. Unnithan, Principal Scientist, NBFGR, Lucknow (26th April 2001).

Mr. N.A. Vohra, IAS, Commissioner of Fisheries, Gujarat (30th May 2001).

Mr. P.K.R. Panicker, former Deputy Commissioner, Gujarat (24th August 2001).

Dr. D.Sudarsan, D.G.(Retd.) FSI; Hon. Professor (A.U) (28th October 2001).

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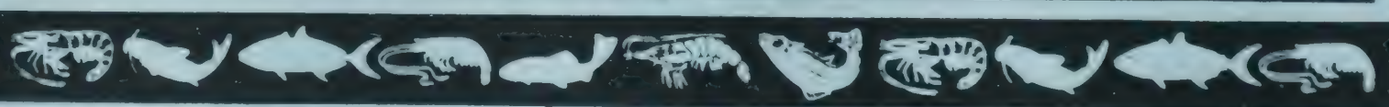

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JANAKEEYA MATSYA KRISHI

(A successful people's campaign for aquaculture in Kerala)

Sanjeeva Ghosh
Joint Director of Fisheries, (Special Officer, JMK Programme)
Directorate of Fisheries, Vikas Bhavan, Thiruvananthapuram, Kerala, 695 033

The advent of the three tier Panchyat Raj System in Kerala at the village, block and district level turned out to be a harbinger of Local Self Government (LSG) and of people's participation in the governance at local level. Local governance gave emphasis to the mobilization of resources available at local level for taking up development projects, with the active participation of the local people. The implementations of the planned Projects has also enabled their percolation to the grass root level. So much so, in Kerala, planning for the 9th five year plan was done starting at village level, as a campaign. This is called 'Janakeeya-sootharanam' or People's Participatory Planning,which turned out to be a successful programme. As part of this programme, elaborate reconnaissance of various potential resources was done at the grama panchayat level for taking up development programmes. As a result of this survey, enormous information and data on the availability of natural resources, that can facilitate immediate development, were generated.

The extent of ponds and tanks available in the State as per the existing statistical data was estimated to be only 3,300 ha. Data were not available in respect of some other important water resources like panchayat ponds, irrigation tanks etc. In this background, the Development Reports (*Vikasana Regha*) prepared by the panchayats as part of the 'Janakeeya-sootharanam' showed that there were more than 60,000 hectares of inland water bodies in Kerala readily available for taking up a fish culture programme. The report pointed out that a majority of these areas were remaining idle now.

The presence of 60,000 hectares of inland water bodies in Kerala, especially of ponds and tanks, posed a new development-oriented issue to the planners and developmental agencies in the State. As a follow-up, the panchayat level task forces began to formulate a number of aquaculture projects based on the newly gathered data of the available water resources.

At this stage, the Department of Fisheries was forced to review the role of various agencies working for the development of fish culture in the State. As a result, it was found that 21 agencies had been working exclusively for the development of fish culture in the State since the last decade. But, the total area they could cover altogether for fish culture till 1997 was below 1,500 ha.

Fourteen Fish Farmers' Development Agencies (FFDAs), six Brackishwater Fish Farmers' Development Agencies (BFFDAs) and one State level 'Agency for Development of Aquaculture, Kerala' (ADAK) have been working with the prime objective of developing aquaculture in the State. An appraisal of the performance of these agencies revealed certain relevant reasons for the low profile of functioning of these agencies and for the tardy progress made by them in covering more areas for fish culture. Some of the important drawbacks noticed are the following:

1. Lack of awareness among the people regarding the techno-economic aspects of fish culture.
2. Lack of the required capital for developing fish culture.
3. Difficulties in getting bank loans.
4. Rigidity in the norms for granting subsidies and financial assistance.
5. Lack of technical expertise and manpower in majority of the developmental agencies.
6. Non co-operation of the local bodies and other departments in lending the water bodies owned by them for taking up fish culture programmes.
7. Non-availability of the needed quantity of quality fish seed for stocking of tanks and ponds.

While considering the above, the State Government suggested that the Department of Fisheries should bestow a concerted and dedicted effort for mobilising action for the utilization of the available water resources throughout the State by taking up various aquaculture programmes, in a sustainable manner with the active support and participation of the local bodies.

In compliance with this directive, and considering the pressing demands from the local bodies for the immediate implementation of fish culture programmes, a series of meetings and discussions were held by the Department of fisheries with the active participation of the Fisheries scientists, planners, technocrats, representatives of local bodies and fisheries research and educational institutions, farmers, etc, for evolving a practical scheme for the utilization of all the available and suitable water bodies in the inland sector of the State for aquaculture. After planning in detail, the Department of Fisheries formulated a mega project for a State-wide campaign for fish culture, viz., the 'Janakeeya Matsya Krishi' (JMK) to be implemented with the co-operation and participation of the local bodies.

Janakeeya Matsya Krishi

The 'Janakeeya Matsya Krishi' was envisaged as a campaign programme aimed at creating an awareness towards meaningful utilization of water bodies for the culture of fishes and shell fishes. In this context, JMK was designated as a people's participatory programme for the utilization of water bodies by attracting neo-farmers and unemployed youth to the field of fish culture.

The Janakeeya Matsya Krishi programme was proposed to be implemented in all the local bodies having

aquaculture and other fisheries potential. The programme encompassed provisions for generating local level developmental initiatives for enhancement of fish production, through promotion of fishery and allied activities.

The Basic Objectives of this Campaign are : 1) To create awareness among people regarding the necessity of utilising all suitable water bodies in the State for appropriate aquaculture activities. 2) To demonstrate the techno-economic feasibility of various eco-friendly and viable aquaculture models in all the local bodies with the active participation of the people. 3) To augment fish and shell fish production in the inland waters of the State. 4) To mobilise voluntary participation of people in the development of fisheries at local level. 5) To create more employment potential in the field of fisheries, and 6) To protect and enrich the healthy water environment of the State.

Implementation of the JMK programme was envisaged to be undertaken with the co-operation of local bodies and participation of the local people. A two-stream approach was adopted by the Department of Fisheries for the implementation of this programme. In the first stream, the Department of Fisheries implements various components of the programme through the fourteen FFDAs and six BFFDAs having working jurisdiction over all the districts of the State. Through this stream basic activities like survey, training, demonstration and fish culture are planned to be taken up throughout the State. In the second stream, the Department of Fisheries extends financial and technical assistance to the local bodies for identifying, formulating and implementing fisheries and other allied projects that come under the jurisdiction of the concerned local bodies.

Programmes under the stream-I are implemented in a phased manner through the FFDAs and BFFDAs. Phase-I of the programme is development of freshwater fish culture through the FFDAs and Phase-II is the development of brackishwater fish culture through BFFDAs. The Department of Fisheries provides necessary funds to the FFDAs and BFFDAs for implementing the component programmes relating to Phase-I and Phase-II. Detailed guidelines have been issued for the effective implementation of the various component programmes of Phases I and II. Monitoring of the programmes of JMK is done regularly by the Directorate of Fisheries through a special cell constituted for the purpose. A senior officer of the Department of Fisheries, designated as the Special Officer, JMK co-ordinates the programmes at the State level.

In order to provide proper directives and guidance to the special officer of the JMK programme and for ensuring proper and timely implementation of the programme at the State Level, a Guidance Council and a State Level Steering Committee have been also constituted. The Minister for Fisheries is the Chairman of the Guidance Council and the Secretary (Fisheries) to Govt., is the Convener. The Guidance Council formulates all the policy decisions and all the programmes. The Director of Fisheries is the Chairman of the Steering Committee which decides all matters relating to the implementation of the programme at the State level. District level steering committees are also set up for deciding matters pertaining to the implementation of the programme at the district level.

JMK - I Phase : Under the I Phase of the JMK, various 'freshwater fish culture' programmes are being taken up throughout the State. Aquaculture activities normally start in July and end by May of the following year. The JMK programme aims at bringing ponds, tanks, irrigation tanks, water logged paddy fields and other freshwater bodies comprising an area of about 10,000 ha under sustainable fish culture, with the active involvement and participation of the farmers and local population. Freshwater ponds and tanks owned by local bodies and government departments are leased out to the interested farmers, neo-farmers or to persons residing around those water bodies coming under the programme for taking up fish culture activities. Fish culture under the programme in big water bodies, are generally taken up as communmity projects, involving the participation of the population living around.

JANAKEEYA MATSYA KRISHI PROGRAMME

STREAM I

DEPT. OF FISHERIES FFDAs/BFFDAs

ASSISTANCE/SUBSIDY/IMPLEMENTATION PROGRAMMES

- Resource Survey
- Training programmes
- Demonstration programmes
- Planning & Formulation of projects for local bodies
- Technical assistance

STREAM II

LOCAL BODIES

ASSISTANCE/SUBSIDY/IMPLEMENTATION PROGRAMMES

- Local Level Fisheries Projects on
  Capture Fisheries
  Culture Fisheries
  Industrial Fisheries and
  Ornamental Fisheries
- Infrastructure Development programmes
- Welfare Programmes

Good quality fish seeds are supplied free of cost to the farmers for stocking their ponds. Seeds of fast growing fishes like catla, rohu, mrigal, common carp, grass carp, silver carp and freshwater prawns are supplied. The type of fish culture encouraged under the JMK programme is 'Composite Fish Culture', involving a compatible combination of the above varieties of fishes.

JMK - II Phase: The II Phase of the JMK programme is devoted to brackishwater fish culture which includes culture of brackishwater finfishes like milkfish, pearlspot and mullets, and shellfishes like shrimps, crabs, oysters, clams etc. However, shrimp culture is identified as the prime programme under the JMK II Phase. Aquaculture programmes in the brackishwater areas generally start by October-November and end by April-May of the following year. The II Phase of the JMK programme is aimed at bringing the maximum extent of brackishwater areas in the Natural Saline Zone (NSZ) of Kerala under aquaculture, in an ecologically feasible, technically viable, economically advisable and legally tenable manner.

JMK : An Approach to the Development of Fisheries in Kerala

Even though the JMK is a programme primarily aimed at utilising the available water resources for aquaculture, it is also conceived as an 'approach programme' for the overall development of the fisheries sector. This is considered to be a homogenous programme to explore and develop the various village level Culture fisheries resources, taking each panchayat as a unit. Cultivable water resources are considered to be of cosmopolitan fisheries potential, present in almost all the panchayats. Hence, promotion of aquaculture is identified as the best approach for generating public awareness regarding the necessity of utilising the water resources for productive purposes. Hence, a multi-pronged stategy is adopted in chalking out various components of the JMK programme. The component programmes aim at:

1) Ensuring the participation of local bodies in the JMK programme by way of getting three persons nominated as motivators from each panchayat;
2) Imparting training to the motivators deputed from the panchayats to motivate the villagers and farmers on scientific fish culture;
3) Conducting a panchayat level primary survey for identifying the potential cultivable water resources available for aquaculture;
4) Evolving appropriate developmental strategies and suitable development programmes for various types of cultivable water bodies;
5) Developing and incorporating local level fisheries projects in the annual plan of the panchayats;
6) Imparting technical know-how through training to the farmers and neo-farmers;
7) Imparting training to farmers in the techniques of fish seed production and seed rearing;
8) Distributing fish seed and fish feed to the farmers free of cost;
9) Formulating panchayat level fisheries plans based on the local fishery resources and helping the local bodies on implementing them; and
10) Helping the farmers in harvesting and selling fishes.

Components of the JMK Programme

The JMK programme is a package of various component programmes. The following are the major components.

1. *Motivational Programme*: The general public and the neo-farmers are to be made aware of the profitability in utilising the waterbodies for fish culture. In order to achieve this, this component programme has been designed to have representatives of people from all the local bodies to function as 'motivators'. The motivators nominated by the panchayats are given special training under the Motivatior's Training Programme (MTP) of the project. They are trained to familiarise them with the different fishery resources and the various aspects of the aquaculture programme.

2. *Survey Programme:* Conducting of field surveys for identifying various fishery resources is one of the important components of the Programme. Detailed observations and collection of data are made to formulate various developmental programmes for implementation in each of the Panchayats. Different survey programmes specially conducted as part of the JMK are the following:

(i) Water Resource Survey: Preliminary survey to find out all the available water resources is conducted by the motivators to make an assessment of the extent of aquaculture area available in their respective local bodies.

(ii) Technical Survey: Technical Survey is conducted for establishing the technical feasibility undertaking culture in already identified. The survey is also meant to decide upon the composition of fish and culture activities to be taken up in the surveyed water bodies.

(iii) Fish Market Survey: Since a substantial increase in inland culture fish production is anticipated through the JMK programme, strategies for marketing the fish produced are also formulated as a component of the JMK programme. Even preliminary information and data about the existing markets and marketing systems were not available. Hence, a quick survey and study on the fish markets and marketing in Kerala was taken up as a special programme. The Janakeeya Matsya Krishi Special Cell of the Directorate has already completed this survey and a detailed report has been published.

(iv) Resource Data Base: Based on the extensive survey carried out by the motivators and the technical staff of the department, a compendium of panchayat level resource data, viz., Panchayat Fisheries Resources Data Book, shorty called 'PANFISH BOOK', has been prepared. The PANFISH BOOK containing the panchayat resource data enables the local bodies to develop their own panchayat level fisheries plans known as 'PANFISH PLANS'. The Panfish books soon to be compiled at block, district and state levels, will provide a strong data base for the fisheries sector of Kerala. ☞

Panfish books are designed as authentic Fisheries Resources Data Books which can be used for multifarious references by the planners, administrators, students, scientists and general public as well.

3. Establishment of Mini Hatcheries : Timely supply of quality seed of desired species in required numbers is a pre-requisite for the successful implementation of the Janakeeya Matsya Krishi. Seed production in the State is limited to a few hatcheries in the public as well as the private sector. Even when the production capacity of these hatcheries is fully harnessed, the fish seed requirement of the JMK programme cannot be met in full. Hence the establishment of mini hatcheries has been taken up as a component of the JMK programme. As part of promoting and extending fish culture in tanks and ponds at the panchayat level, 100 mini hatcheries are proposed to be set up in selected panchayats under the auspices of FFDAs and BFFDAs.

4. Fish Seed Rearing Programme: Under the JMK programme, farmers with small pond holdings who come forward for taking up fish seed production are also encouraged to undertake fish seed rearing under the guidance of the FFDAs. They are supplied fish spawn free of cost by government farms for rearing. Necessary technical training in raising seed from spawn stage is imparted to them. The fish seed produced by the farmers is bought back by the FFDAs for distributing among the JMK farmers. The fish seed raising programme has been a great success. It has opened up new job opportunities. Fish seed produced through the programme is fully utilized for the JMK programme.

5. Training Programmes: JMK involves various training programmes. Practical training is imparted to the motivators, seed raising farmers and fish farmers in a way that they gain hands-on experience through doing and learning processes.

Motivators nominated by the local bodies are given field training in the conduct of fishery resource survey. Motivators' Training Programmes (MTP) are organised at panchayat, block and district level.

The fish seed raising farmers, selected by the motivators and the technical officers of the FFDAs, are given practical training on various aspects of fish seed production. Through the Rearing Farmers Training Programme (RFTP) hands-on-practical training is imparted to all the seed raising farmers at their farm sites.

All the fish farmers participating in the JMK progrmme are imparted training on the different aspects of fish culture. Farmers Training Programmes (FTP) are conducted at Panchayat or block level depending upon the number of participating farmers.

Trainer's Training Programmes (TTP) are organised for the benefit of all the technical staff involved in the JMK programme. Special training programmes on specific tasks are also organised under the JMK for the benefit of the extension staff and the field staff of FFDAs and BFFDAs.

A successful Campaign

Janakeeya Matsya Krishi programme has been a great success. It could achieve its targets well before the scheduled time. Participation by all the local bodies in JMK has rendered it into a mass campaign and movement encompassing the whole State. A distinctive achievement of JMK is the mobilisation of the expertise of all academic, research and developmental institutions in the fisheries sector for the field programmes. Scientists, technocrats, bureacrats, other officials and administrators put their heads together and worked hard to make this programme a grand success. Students belonging to various Universities and other academic institutions in the State have also participated in field activities of JMK in a manner that they could instill motivation and initiat among the farmers. Massive mobilisation of voluntary services for the extension, survey and farming activities has been one of the remarkable achievements of JMK programme.

Participation of local bodies in JMK programme is almost complete. Those local bodies having little potential for aquaculture do not come in the fold of this programme. Details of the participation of the local bodies in the programme for the last four years are as follows :

S. No	Type of Local Bodies	No. of Local Bodies participated			
		1997-98	1998-99	1999-2000	2000-2001
1.	Grama Panchayat	694	770	817	876
2.	Municipality	32	37	43	46
3.	Corporation	2	2	2	3

The JMK programme could achieve fully the annual physical target set for the area coverage under fish culture. The physical targets and achievements for the last four years are as follows:

Year	Culture Area Targetted (ha)	Cultured Area (ha)
1997-1998	3,000	3,257
1998-1999	6,000	6,620
1999-2000	10,000	9,149
2000-2001	10,000	10,188

Details of area coverage under fish and shrimp culture as per JMK Phase I & II programmes are as follows:

S. No.	Fish Culture	Area brought under culture (ha)			
		'97-'98	'98-'99	'99-2000	2000-'01
1.	I Phase-Freshwater	2,937	5,685.37	7,934.90	8,560
2.	II Phase- Brackishwater	320	934.84	1,214.13	1,628
	Total	3,257	6,620.21	9,149.03	10,188

In respect of the participation of the farmers also the JMK programme has met with a great success. By the end of the 4th year more than 40,000 farmers have activity engaged in fish culture programmes. The details are as follows:

Sl. No.	Fish Culture	Number of Farmers Participated			
		'97-'98	'98-99	'99-2000	2000-'01
1.	Freshwater	22,257	29,492	38,298	41,854
2.	Brackishwater	1,816	3,171	4,441	4,632
	Total	24,073	32,663	42,739	46,486

The seed production (seed raising) initiative taken up by the farmers under JMK could set up a new model project for local level seed production viz., Fish Seed Rearing Unit (FRU). During the last four years, fish seed produced at the farmer's level FRUs has been more than the total number of seed produced by the government sector hatcheries in the State. The details of fish seed production from the FRUs are as follows:

S. No.	Details of Seed rearing	Progress Details			
		'97-'98	'98-'99	'99-2000	2000-'01
1.	No. of Fish Seed Rearing units	141	141	262	274
2.	Seed Rearing in Area (ha)	8.95	11.79	17.43	20.1
3.	Spawn used for Rearing (lakhs)	241.08	346.50	661.22	814.79
4.	Seed Produced by FRUs (lakhs)	17.88	46.54	107.81	244.50

*

S. No.	Type of Seed Production Centre	'96-'97	'97-'98	'98-'99	'99-2000	2000-'01
1.	Fish Seed Farms/ Hatcheries	9	39	57	72	79
2.	Fish Seed Rearing Units	-	44	78	261	274

The programme for establishing 100 mini-hatcheries by the FFDAs, under the JMK also made commendable progress. The progress achieved in establishing mini-hatchery units and Fish Seed Rearing Units (FRU) is given in the table as above*.

The requirement of fish seed for JMK for the last four years had to be met from various sources, including those of other States. The details of fish seeds used for the programme for the last four years are as follows:

S. No.	Type of seed	Fish/Shrimp Seed used for JMK (lakhs nos)			
		'97-'98	'98-'99	'99-2000	2000-'01
1.	Freshwater Fish Seed (I Phase)	108.88	274.28	360.81	428.00
2.	Shrimp Seed (II Phase)	73.10	159.27	170.70	225.60
	Total	**181.98**	**433.55**	**531.51**	**653.60**

Annual production of inland fishes in the State has been substantially increased as a result of the implementation of JMK programme. The average productivity of freshwater fishes from the inland water bodies also increased from less than 1,000 kg/ha to 2,600 kg/ha due to the impact of JMK. JMK could also make a perceptible impact on the annual inland fish production in the State. The average annual inland fish production prior to the implementaion of the JMK programme was 49,960 t. But, after the implementation of the programme the production has increased to 66,070 t. The details of fish production from the JMK programme for the last three years are as follows:

	'94-'95	'95-'96	'96-'97	'97-'98	'98-'99	'99-2000
Annual Inland Fish production (Tonnes)	48,192	49,586	52,105	58,215	65,855	74,130
Annual Average	**49,960**			**66,070**		

The expenditure incurred for the implementation of the JMK programme during the last four years are as follows:

Year	Budget Provision	Provision (Rs./Lakhs) for the programmethrough	
		Dept. of Fisheries	Local Bodies
1997-1998	500	250	250
1998-1999	380	180	200
1999-2000	200	100	100
2000-2001	200	150	50
Total	**1,280**	**680**	**600**

FUTURE PROGRAMMES

As mentioned earlier, JMK programme has served a tool and provided an approach has served for the overall development of the fisheries sector of the State through peoples' participation. In future, the Department of Fisheries will intensify its technical support to the local bodies in formulating and implementating local level fisheries projects by facilitating their incorporation in the annual and five year plan programmes of the local bodies.

In order to strengthen the local bodies by providing them with sufficient database required for formulating viable projects based on local resources, the Department, of Fisheries took up an extensive survey programme named PANFISH survey, for collecting fishery resource data from all the Panchayats, Municipalities and Corporations. Based on the data and information thus collected, the Department of fisheries prepared Panchayat Fisheries Resource Data Books, 'PANFISH BOOKS' for the local bodies in the State. These Panfish Books will be used by the local bodies for developing Panchayat Fisheries Plans viz., PANFISH PLANS containing a package of local level fisheries development projects. The year 2001-2002 being the terminal year of the ninth five-year plan the mounting of a massive campaign for developing PANFISH Plans for all the local bodies in the State has now become imperative. The programme related to this campaign would be to develop panchayat level five-year fisheries schemes for incorporating them in the ensuring tenth five-year plan of the State.

PCR Test Facilities for WSSV

For detecting White Spot Syndrome Virus, the PCR laboratories of MPEDA at various centres are equipped to conduct the following tests : MBV, necrosis, gut muscle ratio, stress (formalin, salinity and temperature) and length of PL. Farmers can approach MPEDA centre nearest to them to avail of the facility.

Ocean Star International : Product Profile

Ocean Star International Inc.U.S.A., (OSI) is one of the pioneering companies in the world of producing high quality shrimp hatchery feeds. Its primary products include the following:

1. Brine Shrimp Eggs (*Artemia franciscana*) cysts from the Great Salt Lake, USA; 2.Brine Shrimp Flakes; 3.Black Brine Shrimp Flakes; 4.Spirulina Flakes; 5.American B.P.; 6.Black Algae Powder; 7.Spirulina Powder; and 8.Tropical Fish Flakes/Pellets and Koi Feeds.

OSI was incorporated in 1985 to fulfill the demand for live and artificial feeds needed to raise seed of fish and shrimp. It was stated to be one of the pioneering companies that was set up to fullfil this need by way of large scale production and supply of brine shrimp eggs (artemia cysts).

OSI's brine shrimp operation includes their harvesting, processing and marketing. OSI is licensed by the State of Utah to harvest artemia cysts from the Great Salt Lake. After harvesting, the artemia cysts are processed at OSI's Utah plant. Over the years, OSI has worked to improve its processing techniques. The result has been as increase in the quality of brine shrimp eggs produced by the company.

OSI's Artemia Cysts are used in over 25 countries around the World including India, Bangladesh, P.R.China, Thailand, Japan, Taiwan, Philippines, Indonesia and several South American countries. Customers include large to small private commercial hatcheries, government-run commercial hatcheries, researchers in universities, toxicology laboratories, public aquaria and even home hobbysts. In 1994, OSI's Brine Shrimp Eggs were sent into space for advanced bioresearch.

In 1988, OSI began its production of a variety of artificial feeds. These include an assortment of brine shrimp flakes. OSI currently produces three types of brine shrimp flakes with crude protein values ranging from 53-59% and crude fat values ranging above 12%. These diets contain a complete vitamin package including stabilising vitamin C to help in disease resistence. An assortment of other speciality ingredients to help in disease resistance and colouration is also included. It is stated that diets are designed to colour the water so as to inhibit shrimp from swimming towards light and crowding at the water surface.

OSI has also developed an assortment of powdered feeds. These include American B.P. which is a microencapsulated diet. The advantage of this feed is that its small particle size is readily accepted by very small animals. The encapsulation process helps to reduce leaching of the nutrients from the food practicle, thereby allowing the animal to obtain more nutrition with each bite. This diet contains a high level of fat when compared to other diets. Fat serves to spare ingested protein for growth through the so-called protein sparing effect, it is mentioned.

OSI also produces a micro-particulate diet called Black Algae Powder. It is made from an assortment of mixed ingredients. This product is especially good at colouring the water. It can yield very rapid growth rates due to it high protein (clover 60% crude protein) content.

OSI also supplies Spirulina Powder to the aquaculture industry. This product can be used by itself or custom mixed with other feed ingredients. It is an excellent source of pigments for helping to colour a variety of animals and it contains anti-bacterial properties that may help to reduce diseases, the company says.

OSI is understood to have strong sales of its artificial feeds in India, Bangladesh, Thailand, China, Indonesia, Philippines, Taiwan and in several South American countries. Since all of its artificial feeds are made in the USA from feed ingredients obtained in the USA itself, it is believed that there is no risk of mad cow disease emanating from OSI products.

OSI also has been operating a large-sized shrimp hatchery in the Philippines for the past fifteen years. It is stated that through this facility all of OSI's hatchery feeds are tested in a commercial setting.

In China's Hainan Province OSI also operates a large shrimp farm. The farm has been in operation for 5 years and will eventually have over 100 ha of pond surface area. Typically production has been in the range of 6.7 metric tonnes of shrimp (52-65 kg size) per ha. This farm enabled OSI to better understand the relationship between good quality post-larval shrimp seed stock produced with high quality feeds, and the production of high pond yields.

In 1989 OSI expanded its range of feeds to include as assortment of tropical fish feeds. These include both flake and pellet products which are designed for an assortment of marine and freshwater tropical fishes. OSI also markets a line of feeds especially designed for Koi and other ornamental pond fishes. Production of feeds for these animals has given OSI an exceptionally broad based understanding of how to feed an assortment of species. As a result, OSI now claims to be the largest company in the world that is successful in both aquaculture and tropical and artificial feed businesses.

OSI has also branched off into the production of pharmaceutical drugs for human use in China. OSI is understood to be also planning to introduce a line of medications for aquatic animals including fish and shrimp.

Regarding future, it appears that OSI's goal is to continue to develop new feeds and refine feeds currently being produced in order to meet customers' needs. OSI is also seen to continue to be conscious of customer costs and produce feeds that are of high quality and yet economical that will allow the customer to earn maximum profit.

Enhancement : An Effective Tool for Increasing Inland Fish Production

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In India, fisheries have always been playing a pivotal role in the food and nutritional security of people, especially in the rural areas. Inland fish production in the country registered an impressive growth during the last fifty years. From 0.2 million t in 1950-51, the annual inland fish production rose to 2.8 millions t during 1999-2000. Over the years, growth in the marine sub-sector has slowed down considerably due to dependence on the wild stocks of fish, which are obviously being over-exploited. Conversely, contribution of inland fisheries to the total fish production has increased from 29% in 1950s to 50% by 1999-2000 (Table 1). During this period, fish production systems in the inland waters have not only been expanded but also have been diversified, intensified and technologically advanced. Most of the inland water bodies are captive ecosystems, providing opportunities for intensive human interventions in promoting biological production process. In many developing countries, aquaculture has been given high priority to improve the availability of protective food for their undernourished peoples and also to cater to the overseas trade.

Any irrational growth of capture fisheries and aquaculture ventures, impervious to environmental norms, can open up a floodgate of new concerns, as evident from the recent Asian experience of shrimp culture boom. In recent years, clear signs of over-exploitation of important capture fish stocks, modification of ecosystems, significant economic losses and international conflicts on management and fish trade have become discernible. This could threaten the long-term sustainability of fisheries and contribution of fisheries to food supply. It has now been realised that living aquatic resources, although renewable, are not infinite and need to be properly managed, if their contribution to the nutritional, economic and social well being of the growing world's population is to be sustained.

In spite of the phenomenal increase in fish production during the last five decades, the per capita availability of fish in India continues to be very low at 8 kg per head, against the world average of 12 kg. In order to fulfill the minimum nutritional requirement as stipulated by the WHO standards, a person needs 11 kg of fish/year. Assuming that 56% of the population include fish in their diet, the country currently needs at least 6.3 million t of fish per annum (Sugunan and Sinha, 2001). Thus, the current shoftfall of fish production is about 0.7 million t. Since marine fishery has reached a plateau in growth rate, most of the shoftfall in future has to be met from inland fisheries.

Table 1. Increase in Fish Production in India

	Marine	*Inland*	*Total*	*% of Inland fisheris*
1950-51	0.5	0.2	0.8	29.0
1960-61	0.9	0.3	1.2	24.1
1970-71	1.1	0.7	1.8	38.2
1980-81	1.6	0.9	2.4	36.3
1990-91	2.3	1.5	3.8	40.0
1997-98	2.8	2.4	5.2	46.2
1998-99	2.9	2.5	5.4	46.3
1999-00	2.8	2.8	5.6	50.0

Rivers, estuaries and the lagoons, being under the threat of environmental degradation, are not expected to play a significant role in meeting the additional requirements of inland fish production in India. The country has 14 major, 44 medium and innumerable small rivers, but their fish yield is fast decreasing. Fish production in many stretches of the river Ganga has declined at an alarming rate during the last five decades. Similar fall in yield rete has been reported from the Brahmaputra. Water abstraction, sedimentation, dam construction and other habitat destruction activities are responsible for the loss of riverine fishery. Fisheries of all the enstuaries and lagoons of India are also under threat due to habitat degradation (Sugunan and Sinha, 2001). Unchecked growth of intensive aquaculture may open up many new environmental, social and legal issues. Thus, the eco-friendly option of developing culture-based fishery in small reservoirs and fooldplain lakes, coupled with stock and species enhancement in large reservoirs, holds the key for future inland fisheries development in India (Sugunan, 1995,1997 a,b & 2000). However, these norms lack conceptual clarity due to the absence of clear-cut definitions. Since semantic confusion regarding management norms is very much evident in the literature, an attempt is made here to define and explain some of them.

Capture fisheries, Culture-based fisheries and enhancements

In a typical capture fishery, the wild untended stock of organisms is harvested with little human intervention on either habitat variables or the biotic communities. On the other hand, in a culture fishery, the whole opetation is based on cap-

tive stocks with a high degree of effective human control over the water quality and other habitat variables. The exploitation of marine fisheries is an example of capture fisheries and aquaculture of fish, shrimp and prawn in small ponds is an example for culture fisheries. Fishery management system as applied to marine capture fisheries is seldom applicable to the inland capture waters of India, with the possible exeption of rivers and estuaries. Most of the open waters which contribute substantially to fish production such as reservoirs, *beels, boars, chaurs, etc.* are managed on the basis of *culture-based fisheries* or in various forms of *enhancement,* which are intermediate to culture and capture fishery norms.

What is Enhancement

A range of management practices is collectively known as enhancement. Lorenzen *et al.* (2000) defines it as limited interventions in the life cycle of common pool resources. FAO (1997) defines fisheries enhancements as technical interventions in existing aquatic resource systems, *which can substaintially alter the environment, institutional and economic attributes of the system.* Enhancement is the process by which qualitative and quantitative improvement is achieved from water bodies through exercising specific management options. The common forms of enhancement which are relevant to inland water bodies of India are stock enhancement, species enhancement, environmental enhancement, management enhancement and enhancement through new culture systems. Culture-based fishery is the most common mode of enhancement being followed in inland water bodies in India.

The Rationale

The rationale of enhancements is that under certain conditions, limited technological interventions can sustainably increase the utilisation of natural aquatic productivity. Stocking of hatchery-reared fish seed, for example, can substantailly increase the yields of desired species where natural productivity is high but recruitment of desired species is limited. Habitat enhancements can have similar effects. Because enhancements largely rely upon natural productivity, they require little feed or energy inputs, and at the same time can provide high returns on limited investments. Hence enhancement provides opportunities of securing economic power, in particular for resource poor sections of inland and coastal aquatic resource users. Moreover,introduction of enhancement technologies in common pool resources may facilitate institutional changes leading to more efficient and sustainable exploitation of resources (Lorrenzen *et al.*, 2000)

Role and Scope of Enhancements

Contribution of enhancement to fish production has been reviewed at the Conference on Aquaculture in the Third Millennium at Bangkok (Lorenzen *et al.*, 2000). The review came to the conclusion that global contribution of enhancements tend to be assimilatled into the statistics of either capture fisheries or aquaculture production. It is very apparent that enhancement yields are dominated by culture-based fisheries for freshwater and diadromous species. Annual yields in this category are likely to be around 2 million t including 1.3 million t from Chinese reservoirs (Huang *et al.*, in press), o.4 million t from salmon in North Pacific (Shaw & Muir, 1987 and Kaeriyama, 1999, Knapp, 1999), and 0.18 million t from Indian inland waters (Sugunan, 1997; Lorenzen *et al.*, 2000). Culture-based fisheries for food and recreation are well established components of aquatic resource use in Europe (e.g., Mattern, 1999) and in North America where State fisheries organizations expend an average of 19% of their budgets for stocking in cultivable waters (Heidinger, 19999; Ross & Loomis, 1999). Overall, the estimate of 2 million t per year suggests that culture-based fishery of freshwater and diadromous organisms account for about 20% of recorded capture yields, or 10% of combined capture and culture yields in this category (total yields 7.5 and 21.2 million t respectively, FAO, 1999a).

Contributions to fish production of enhancements other than culture-based fisheries are poorly documented. However, it has been estimated that brush parks (acadjas) account for 12,000 t or 40% of the inland fisheries production of Benin. Similar systems are in use in other African and Asian countries (Kapetsky, 1981; Solarin Udolisa, 1993). Habitat enhancements using such indigenous technologies are more widespread in tropical inland waters their importance has long been realised (Neiland & Labu, 1997; Schemidt, 2000).It has been recorded that 1.6 million t of fish is produced through inland aquaculture in India (Gopakumar, 1999). The remaining 1.2 million t inland fish is attributable to different type of inland open water systems. Although the break-up of catches from rivers, lakes, floodplain wetlands and reservoirs is not recorded, it is generally believed that the capture fisheries of rivers and estuaries contribute very little to the total inland catch. Bulk of production from open waters emanates from reservoirs, small irrigation impoundments and floodpain wetlands. The main focus of management in these water bodies is related to culture-based fisheries and fisheries enhancement.

Unique Systems

Enhancements are described as unique production systems. Even though the technolgical interventions may be limited and relatively simple (e.g., stocking of seed fish), the degree of management control over enhancement outcomes is inherently restricted. This is a consequence of both the limited nature of interventions in ecosystems not managed primarily for fish production, but as part of the common pool nature of the resource. Common pool resources are exploited jointly by separate users, resources use by one individual substracts from the use of others, and the exclusion of users is difficult (Ostrom 1990). In such circumstances, the actions of resource users are difficult to predict, let alone control.

Lorenzen, *et al.*,(2000) described that resource management agencies and scientists may influence technology choice with interactions and institutional ar-

rangements at various levels. However, our ability to predict and influence outcomes will remain somewhat limited, and strongly dependent on our understanding of the overall production system (Lorenzen & Gateway, 1989). This implies firstly a need for managers and scientists to develop a broadbased understanding of enhancement systems. Secondly, as predictability of outcomes is inherently low, strategies for developing new enhancements must be processed rather than looked at as outcome-oriented.

Opportunities and constraints

Enhancement techniques provide opportunities in particular for resource poor sections of inland and coastal resource users. Enhancement initiatives can facilitate institutional change and a more active management of aquatic resources, leading to significant productivity, conservation and wider social benefits. Introduction of enhancement technologies in common pool resource users may also facilitate institutional changes leading to more efficient and sustainable exploitation of resources. Enhancements may help to maintain abundance of community structure and ecosystem functioning in the face of heavy exploitation and/or environmental degradation.

The Bangkok declaration and strategy, a blueprint for aquaculture development for the new century, released at the end of Millennium Conference of Aquaculture, underscored the importance of enhancement as a practice providing important opportunities for resource poor sections of the population to benefit from relevant aquaculture technologies and permit effecient use of underutilized new or degraded resources. The declaration goes on to state that the full potential of culture-based fisheries could be achieved by:

- Creating conductive institutional arrangements to enable and sustain investment in common pool resources,
- Providing appropriate research and development inputs,
- Managing environmental and other external impacts, and
- Promoting effective cooperation and information exchange.

Negative environmental impacts may arise from ecological and genetic interactions between enhanced and wild stocks. Many enhancements take place without realising their full potential because of failure to address the specific institutional, technological, management and research requirements emanating from two key characteristics. Fisheries enhancement entails investments in common pool resources and can be sustained under institutional arrangements that allow regulation of use and flow of benefits to those who bear the costs of enhancements. Secondly, technological interventions are limited to certain aspects of life cycle of stocks and outcomes are strongly dependent on natural conditions beyond management control. Hence, management interventions must be adapted to local conditions to be effective, and certain conditions may preclude successful enhancement altogether. Governments have a major role to play in facilitating enhancement initiatives through the establishment of conducive institutional arrangements, appropriate research support and the management of environmental and other external impacts on and from enhancements.

Enhancement *vis-a-vis* Sustainability

Sustainable development, according to the FAO, *is the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations.* Such sustainable development should be environmentally non-degrading, technically viable and socially acceptable. Sustainability, as applied to fisheries development is relevant to both capture and culture systems and their products, which are designed to maintain productivity and usefulness to society without any time limits (Gopalakrishnan, 1999). However, compared to intensive aquaculture, capture and culture-based fisheries provide management options, which are more compliant with the norms of sustainable development. Most of the open waters, such as reservoirs, *beels, boars, chuars* and others, which contribute substantially to fish production, are managed on the basis of culture-based fisheries or various other forms of enhancements, which are intermediate to culture and capture fisheries norms. These modes of fishery management offer relatively eco-friendly options for sustainable management of resources.

Different Forms of Enhancements

Enhancement can be in the form of improving the stock, through changing the exploitation norms, changing craft and gear, introducing new forms of access and so on. Apart from improving the production of absolute biomass from the water bodies, it can also be in the form of interventions on access to the fishery or improvements in their monetary and aesthetic value. The common norms of enhancement, which are relevant to inland water bodies of India, are: i) Stock enhancement, ii) Species enhancement, iii) Environmental enhancement, iv) Habitat enhancement, v) Management enhancement, and vi) Enhancement through new culture systems.

Stock Enhancement (increasing the stock) : Augmenting the stock of fish has been the most common management measure that is followed in the reservoirs in most countries of the world. Augmentation of the stock is necessary, to prevent unwanted fish to utilise the available food niches and flourish at the cost of economically important fast-growing species to colonise all the diverse niches of the biotope, and this is one of the necessary pre-requisites in reservoir fishery management. The main aspects of stock enhancement are selection of species of stocking, determination of stocking rate and the size at stocking. There are two types of stock enhancements *viz.,* (1) stocking to create a culture-based fisheries i.e., fisheries based predominantly on the recapture of stocked fish and (2) Stocking to enhance or supplement self recruiting popula-

tions.

Species Enhancement : Species enhancement is planting of economically important, fast growing fish from outside with a view to colonising all the diverse niches of the biotope for harvesting maximum suistainable crop from them. It can be just stocking of a species outside its range of natural distribution. Introduction can be by way of stocking taking place accidentally or deliberate stocking with the objective of establishing its naturalised populations (Welcomme & Bartly, 1998). This widespread management practice has more relevance in respect of larger water bodies where stocking and recapture on a sustainable basis is not feasible. Introduction of exotic species is a subject of hot debate due to its possible impact on the biodiversity of the natural aquatic ecosystems.

Environmental Enhancement : Environmental enhancement is improvement of the nutrient status of water by the selective input of fertilisers (Sugunan, 1995,2000). Although this is a common management option adopted in China(Sugunan, 1997b), a careful consideration of the possible impact on the environment is needed before this option is resorted to in reservoirs.

Habitat Enhancement : A wide range of habitat enhancements is being carried in our inland and marine fisheries, using traditional as well as recently developed technologies (Williams, *et al*., 1997, Cowx & Welcomme, 1998; Morikawa, 1999). The effectiveness of these measures has often proved difficult to evaluate due to the time scales involved in responses, the levels of natural variation in natural habitat and recruitment, and institutional impediments to monitoring and evaluation (Kershner, 1997; Munro & bell, 1997). As a result, little scientific guidance can be given with respect to the choice of habitat enhancement technologies.

A common effective habitat enhancement fould in tropical Africa and Asia is the construction of brush parks, such as *acadjas* in West African lagoons. Brush parks provide substrate for periphyton production and protection from certain predators in addition to serving as fish aggregtion devices. In the lagoons of Benin, production from brush parks has been estimated as 1.9 to 5.6 t/ha/year (Welcomme, 1972), substantially higher than the average production in Nigeria (Solrin & Udolisa, 1993).

Other Enhancement Methods : There are other forms of enhancements such as management enhancement when new management options are excercised. For example, a water body can be thrown open for sport fishing to attract fishers or a community management approach can be adopted in a privately owned water body and vice-versa. New culture systems such as cage and pen culture can be resorted to, to augment yield and increase revenue.

Culture-based Fisheries

When the fish harvest in an open water system depends solely or mainly on artificial recruitment (stocking), it is referred to as a *culture-based fishery*. This management tool is particularly effective in increasing yields when recruitment of desired species is lower than the enviornmental carrying capacity. This is the case in certain modified ecosystems (e.g. reservoirs) or where intensive harvesting has reduced spawning stocks to very low level. Chronic recruitment limitation can also arise naturally in seasonal and/or isolated freshwater bodies, or in marine habitats with poor connectivity to spawning sources (Doherty, 1999). The floodplain wetlands, small reservoirs and a number of community water bodies in India fall under the above mentioned situation. On many occasions, culture-based fisheries can increase yields over and above the level achievable from self-recruiting population of the same species. Thus, culture-based fishery forms an important management tool in the hands of fishery managers in India to increase production and productivity. The main focus of management here is stocking and recapture. The size at stocking, grow out period and the size at capture are the important criteria in culture-based fishery management.

There are many examples of culture-based fisheries that have demonstrated technical effectiveness by increasing yields of desired species: carps in small water bodies (Amarasinghe, 1998; Hasan & Middendorp, 1998; Lorenzen, *et al*., 1998a; Nguyen in press), medium-size reservoirs (De Silva *et al*., 1991; Lu, 1992; Li&Xu, 1995; Lorenzen, *et al*., 1997 Pham and De Silva 2000), in floodplains (Ahmed,*et al* ., 1998), in lakes (Salojaervi, 1992), and scallops in coastal environments (Kitada, 1999). In all of these cases, the stocked species were either absent before enhancement, or their abundance was very much reduced by over fishing. The remarkable technological success of the culture-based fisheries in Chinese reservoirs, which are reputed to have raised avarage yields from 150 to 750 kg/ha/year (Huang, *et al*. 2001), is based on the stocking of riverine major carps that are unable to reproduce successfully under the lacustrine conditions of reservoirs, but can make good use of the available food resources, if stocked.

Effectiveness of culture-based fisheries varies widely among locations, and the reasons for this are often not well established. High mortality of stocked fish is frequently a key limitation. Lorenzen (unpublished)shows that mortality of stocked fish may be slightly lower, or up to an order of magnitude higher than the average for wild fish of the same size. Optimisation of seed production and release strategies may lead to significant reductions in mortality (Bilton, *et al*., 1982; Wahl, *et al*., 1995; Munro and bell, 1997; Leber, 1999). The potential production of culture-based fisheries is strongly linked to ecosystem productivity, as is clearly shown in comparative studies (De Silva, *et al*. 1992; Lorenzen, *et al*. 1998a; and Hasan & Middendorp, 1998). Optimising management regimes so that the given production potential is utilized efficiently remains a key challenge in the management of culture-based fisheries. The assessment of stocking and harvesting regimes require quantitative information on density dependent population dealt with (Peterman, 1995, Lorenzen, 1995). At present

such information can only be obtained by (active or possive) experimental management, but further development of population dynamics theory and meta-analyses may reduce the need for experimental management in the future. So far, few culture-based fisheries have been comprehensively analysed and it is likely that stocking and harvesting regimes are often sub-optiomal (Lorenzen *et al.*2000).

Conclusion

The key for future development in inland fisheries in India lies on effective utilization of 'enhancement' as a management tool. Most of the inland water bodies in India from which the bulk of fish production emanates are managed on co-management basis. Various forms of enhancements with limited technological intervention are the only feasible propositions in these resources. Such interventions are environmentally sensible, economically viable and socially justifiable. There should be concerted efforts from the authorities to identify and develop the water bodies for practising enhancement technologies.

References

AHMAD, I., BLAND, S.J.R., PRICE, C.P. & KERSHAW, R.(1998). Open water stocking in Bangladesh: experiences from the Third Fisheries Project. FAO *Fisheries Technical Paper* **374**:351-370.

AMARASINGHE, U.S.(1998). How effective are the stocking strategies for the management for the reservoirs fisheries of Sri Lanka? In : Cowx, I.G.(Ed.) (1998).*Stocking and Introduction of Fish.* Blackwell Science, Oxford. Pp. 422-436.

BILTON, H.t., ALDERDICE, D.F.& SCHNUTE, J.T. (1982) Influence of time and size at release of juvenile coho salmon (*Oncorhynchus kisutch*) on returns at maturity. *Canadian Journal of Fisheries and Aqutic Sciences* **39**:426-447.

COWX, I.G. & WELCOMME, R.D.L. (Editors) (1998). Rehabilitation of Rivers for Fish. Oxford: Fishing News Books.

DE SILVE, S.S., YU, Z. & XIANG, L.H. (1991) A brief review of the status and practices of the status and practices of the reservoirs fishery in mainland China. *Aquaculture and Fisheries Management 22:73-84*

DE SILVE, S.S. LIN, Y.&TANG G. *(1992).* Possible yield-productive models based on morphometric characteristics and stocking rates for three groups of Chinese reservoirs. *Fisheries Research 13:369-380.*

DOHERTY, P..J.*(1999).* Recruitment limitation is the theoretical basis for stock enhancement in marine populations. In:HOWELL, B,R., MOKSNESS, E. & SVASAND, T.(Editors) *Stock Enhancement and Sea Ranching.* Oxford News Books. pp. 9-21.

FAO (1997). Aquaculture Development. *FAO Technical Guidelines for Responsible Fisheries* **5.**

FAO (1999a). Review of the state of the world Fishery resources: inland fisheries. *FAO fisheries Circular* 942.

GOPAKUMAR, K., 1999. Strategies for increasing inland fish production in India. Souvenir, Central Inland Capture Fisheries Research Institute, Barrackpore 22-23 December, 1999:35 pp.

GOPALKRISHNA, V., 1999. Fisheries of estuaries and coastal lagoons of India-Problems and solutions. Souvenir, Central Inland Capture Fisheries Research Institute, Barrackpore 22-23 December, 1999:35 pp.

HASAN, R. & MIDDENDORP, H.A.J. (1998) Optimizing stocking density of carp fingerlings through modelling of the carp yield in relation to average water transparency in enhanced fisheries in semienclosed water bodies in western Bangladesh. *FAO Fisheries Technical Paper* 374:159-162

HEIDINGER, R,C, (1999) Stocking for spoprt fisheries enhancement. In:Kohler, C.C. & Hubert, W.A.(Eds) *Inland Fisheries Management in North America.* 2nd Edition. American Fisheries Society, Bethesda. pp. 375-401.

HUANG, D., LIU, J. & HU, C. (2001) Fish Resources in Chinese reservoirs and their utilisation. In:Reservoir and Culture-based Fisheries : Biology and Management. Edited by S.S. de Silva. Canberra/Pnom Penh: ACIAR/MRC.

KAERIYAMA, M. (1999) Hatchery programmes and stock management of salmonid populations in Japan. In:Howell, B.R., Moksness,E & Svasand, T.(Editor) *Stock Enhancement and Sea Ranching.* Oxford:Fishing News Books. pp. 153-167.

KAPETSKY, J.M.(1981) Some considerations for the management of coastal lagoon and estuarine fisheries. *FAO Fisheries Technical Paper* 218.

KITADA, S.(1999) Contribution of hatchery enhancement and comprehensive fishery resource management: from Japanese experience. In: Marine Ranching:Global Perspectives with Emphasis on the Japanese Experience. *FAD Fisheries Circular* 943:98-130.

KERSHNER, J.L.(1997) Monitoring and adaptive management. In:Williams J.E., Wood, C.A. & Dombeck, M.P.(1997) *Watershed Restoration: Principles and Practices.* Bethesda : American Fisheries Society.

KNAPP, G.P.(1999) Alaska salmon ranching : an economic review of the Alaska salmon hatchery programme In;Howell, B.R. Moksness, E.&Svasand, T.(Editors) *Stock Enhancement and Sea Ranching.* Oxford : Fishing News Books. pp.537-556.

LABER, K.M.(1999) Rationale for an experimental approach to stock enhancement. In :Howell, B.R., Moksness, E. & Svasand, T.(Editors) *Stock Enhancement and Sea Ranching.* Oxford : Fishing News Books pp. 493-508.

LI, S. & XU, S. (1995). *Culture and Capture of fish in Chinese Reservoirs.* International Development Research Centre, Ottawa, 128 pp.

LORENZEN, K. (1995) Population dynamics and management of culture-based fisheries. *Fisheries Management and Ecology 2:61-73*

LORENZEN, K & GARAWAY C.J.(1998) How predictable is the outcome

of stocking? In:*Inland Fisheries Enhancements,* FAO Fisheries Technical Paper **374**, pp. 133-152, Rome:FAO.

LORENZEN, K. XU, G., CAO, F., YE, J. & HU, T. (1997). Analysing extensive fish culture systems by transparent population modelling : bighead, carp, *Aristichthys nobilis* (Richardson 1845), culture in a Chinese reservoir, *Aquaculture Research* **28**:867-880

LORENZEN, K,JUNTANA, J., BUNDIT, J.& TOURONGRUANG, D. (199a). Assessing culture fisheries practices in small water bodies: a study of village fisheries in Northeast Thailand. *Aquaculture Research. 29*:211-224

LORENZEN, K., Amarasinghe, U.S.,Bartley, D.M., Bell, J.D., Bilio,M., de Silva,S.S.,Garaway, C.J.,Hartmann, W.D., Kapetsky,J.M.,Layele, P., Moreau, J., Sugunan, V.V.,Swar, D.B., (2000). *In* proceedings of the Conference on Aquaculture in the Third Millennium 20-25 February 2000. Bangkok, Thailand.

LU, X., (1992). Fishery Management approaches in small reservoirs in China. FAO *Fisheries Curcular* **854**. 69 pp.

MATTERN, J. (1999). Fischereifachkundefuer Seen, Fluesse and kuestenna Gewaesser. Parey/ Blackwell Wissen-schaft, Berlin.

MORIKAWA, T.(1999). Status and prospects on the development and improvement of coastal fishing ground. FAO *Fisheries Circular* **943**:136-239.

MUNRO, J.L. & BELL, J.D. (1997) Enhancement of marine fisheries resources. *Reviews in Fisheries Science* **5**:185-222.

NEILAND, A.E & LADU, B.M.B (1997) Enhancement of inland fisheries in Nigeria: the institutional context provided by traditional and modern systems of fisheries management. FAO *Fisheries Technical Paper* **347**:371-392.

OSTROM, E.(1990) *Governing the collision : the evolution of institutions for collective action.* Cambridge: Cambridge University Press. 280 pp.

PETERMAN, R.M.(1991) Density-dependent marine processes in North Pacific salmonids : lessons for experimental design of large-scale manipulations of fish stocks. ICES *Marine Science Symposia* **192**: 69-77.

PETERS, D.M. & FEUSTEL, C. (1998).Social and economic aspects of reservoirs enhancement in Kerala. FAO *Fisheries Technical Paper* **374**: 309-322.

PHA, D.P.&DE SILVA, 8.8.(2000) The fishery of the Ea Kao reservoir, southern Vietnam : a fishery based on a combination of stock and recapture, and self-recruiting populations. *Fisheries Management and Ecology* 7:215-264.

ROSS, M.R. & LOOMIS, K.D.(1999). State Management of freshwater fisheries resources: its organisational structure, funding, and programmatic emphasis. *Fisheries* **24**(7):8-14.

SALOJAERVI, K.(1992). The role of compensatory process in determining the yield from whitefish (*Coregonus lavaretus* L.) stocking. Ph.D. Thesis, University of Helsinki.

SCHMIDT, U.W.(2000). Traditional fisheries enhancement systems in Sub-Saharan Africa. Unpublished manuscript.

SHAW, S.A.,& MUIR, J.F.(1987). Salmon:Economics and Marketing. Croom Helm, London, 270 pp.

SALARIN, B.B. & UDOLISA, R.E.K. (1993). An investigation of brush park fishing in Logos lagoon, Nigeria, *Fisheries Research* **15**:331-337.

SUGUNAN, V.V.,(1995). Reservoir Fisheries of India. *FAO Fisheries Technical Paper* 345. Food and Agriculture Organisation of the United Nations, Rome: 423 pp.

SUGUNAN V.V.,(1997a). Guidelines for management of small reservoirs in India. *Fishing Chimes*, **17**:23-27.

SUGUNAN V.V.,(1997b). Fisheries management of small water bodies in seven countries in Africa Asia and Latin America. FAO Technical Circular No. **933**. Food and Agriculture Organisation of the United Nations, Rome, 149 pp.

SUGUNAN, V.V., (2000). Ecology and fishery management reservoirs in India. *Hydrobiologia*, **430**:121-147.

SUGUNAN, V.V., M.SINHA(2001). In. Sustainable Indian Fisheries, Pandian, T.J.(ed.). pp. 43-70. National Academy of Agricultural Sciences.

WAHL, D.H., STEIN, R.A. and De VRIES, D.R.(1995). An ecology framework for evaluating the success and effects of stocked fishes. *American Fisheries Society Symposium* **15**:176-189.

WELCOMME, R.L., 1972. An evaluation of the acadja method of fishing as practiced in the coastal lagoons of Dahomey (West Africe) *Journal of Fish Biology* 4:39-55.

WELCOMME, R.L., & BARTLEY, D.M.(1998). Current approaches to the enhancement of fisheries. *Fisheries Management and Ecology* **5**:351-382.

WILLIAMS, J.E., WOOD, C.A.&DOMDEEL, M.P.(1997). Watershed Restoration: Principles and Practices. Bethesda:American Fisheries Society.

Marine Products Exports 2001-02

According to a report, the provisional trade data for the first half of the current fiscal (April to September 2001), collected by the Directorate-General of Commercial Intelligence and Statistics and compiled by Economic Division of the Commerce Ministry, indicates that the level of exports of marine products, in US $ terms, reached 636.99 million in the first half of 2001-02 (April to September 2001), against US $ 643.84 for the corresponding period for the year 2000-01. The shortfall in the value of exports during the period being about 1.07% or US $ 6.85 million, the exports in the second half are likely to cover up this shortfall, bringing the total exports in 2001-02 atleast to the level achieved during 2000-01. The possibilities, however, as per the present trend is that the exports may marginally cross the value of exports in 2000-01.

Enclosure Rearing of Fish Seed For Reservoir Fisheries Development In Gujarat State

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Background

Sporadic attempts were made to study the ecology and the fisheries of the reservoirs in the country, during the fifties and the sixties of last century. These studies, rather streamlined, were intensified through the Co-ordinated Reservior Project launched by the Central Inland Capture Fisheries Research Institute [CICFRI] in 1971. This project led the way to simultaneously conduct investigations in the reservoirs of different river systems in the country. The data generated through this Project and other similar investigations of the CICFRI have resulted in the development of technologies for the management of fisheries in the large and small reservoirs of the country. These technological developments have paved way to maximize the fishery output to about 80 to 200 kg/ha/year in various small and large reservoirs of the country.

Natural recruitment of the economically important fish species [like the Indian major carps] in the reservoirs is not dependable, due to certain limitations. The fluvial ecosystem of the river changes over to a lacustrine environment when the river is impounded and this change is not normally congenial for the spawning of the Indian major carps. Hence, stocking of fingerlings of the desired species in reservoirs has to be resorted to for augmenting major carp production.

Normally,the initial ten years of the impoundment [Trophic Burst Phase] manifest high level of biomass productivity in a reservoir. If this phase is not taken advantage of to establish the coveted or economically important fish species, the uneconomic [Trash] and predatory varieties may establish and multiply in the system. With an unmanaged wild/predatory fish population, the yield of the selected valuable fish remains low in the reservoirs.

The reservoir fishery management strategy, therefore, aims at using these large water bodies comprehensively, so that they would become self sufficient in fish seed input and the fish yield output. It is in this context that the introduction of Enclosure Culture and Seed Rearing in Pens and Cages of fish seed assumes importance.

Gujarat Scenario

The resource-base for the Inland Fisheries Development in Gujarat consists of the following:

- River systems for the Capture Fisheries
- Reservoirs for Seed Stocking/Culture and Capture
- Ponds/Tanks for Culture Fisheries
- Estuary Systems for Capture Fisheries

The quantification of these resources has been attempted from time to time. The State Fisheries Department, in an estimate made in connection with the preparation of a Master Plan for the Fisheries Development [Anon,1984], identified a total area of 314,000 ha of waterspread, excluding 1,192 Km. of river length, 21,230 ha of estuarine areas and 360,000 ha of coastal land suitable for coastal aquaculture. Of this, 165,000 ha were identified as productive areas, which could yield 32,975 tonnes of freshwater fish through appropriate development strategy. The present of inland fishery resources estimate of the State is summarized here under:

Village ponds/tanks	00.71lakh ha.
Irrigation Tanks	00.40 lakh ha.
Major/Medium Reservoirs	02.43 lakh ha.
Rivers/Canals	3,865 km
Estuaries	00.21 lakh ha.
Brackishwater area	03.76 lakh ha.
Water-logged Areas	00.94 lakh ha.

In addition to the above, it is expected that the upcoming Sardar Sarovar (Narmada Reservoir) would add to the existing freshwater fishery resources in the following manner:

Reservoir Area	:	34,867 ha.
Command Area Ponds/Tanks	:	10,500 ha.
Waterlogged Areas	:	6,000 ha.
Estuarine Area	:	500 ha.

Inland Fish Production

Gujarat produces between 60 to 80 thousand tonnes of inland fish annually. The source-wise production of inland fish in Gujarat for the past few years is detailed below.

Production (tonnes)

Source	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00
1. Reservoirs	5,004	7,158	8,017	12,290	22,772	13,212
2. Brackish Waters	123	241	240	173	176	140
3. Rivers	5,027	7,426	9,637	7,372	9,769	8,484
4. Estuaries	31,668	20,094	16,410	20,912	18,606	10,118
5. Tanks/Ponds	7,013	7,320	5,606	4,011	5,316	5,817
6. Nalsarovar	329	459	79	0	1,160	836
7. Others	21,265	17,919	25,368	25,692	22,268	31,725
Total	70,100	60,158	65,278	70,450	80,068	70,328

The contribution (in percentage) of the reservoir fish to the total inland fish production has been as follows:

Year	Reservoir Fish Production (t)	Share (%)
1994-95	5,004	07.14
1995-96	7,158	11.90
1996-97	8,017	12.28
1997-98	12,290	17.44
1998-99	31,725	45.11

As may be seen the bulk of the present inland fish production in Gujarat (45%) comes from reservoirs.

Reservoirs

The Commissionerate of Fisheries (Anon,1999) estimated that during 1998-99, an area of 242,188 ha. of reservoir-spread has been utilized for the fish production. The total yield of reservoir fish was 22,772 tonnes with an average yield of 94.03 kg/ha. The district-wise reservoir area operated, fish production and the average yield (1988-99) are detailed below.

District	Reservoir Area (ha)	Production (t)	Average yield (kg/ha/year)
Valsad	5,818	180	30.94
Surat	45,069	724	16.06
Ukai	52,000	8,732	167.92
Vadodara	3,601	787	218.55
Bharuch	4,311	678	157.27
Kheda	2,086	0	0.00
Panchmahals	32,163	1,425	44.31
Ahmedabad	296	127	429.05
Banaskantha	7,193	819	113.00
Sabarkantha	12,786	1,874	146.57
Mehsana	10,977	525	47.83
Rajkot	18,964	2,128	112.53
Surendranagar	3,877	575	148.31
Jamnagar	8,007	901	112.53
Bhavnagar	14,751	1,547	104.87
Kachchh	7,759	813	104.78
Amreli	5,147	758	147.27

The Indian Institute of Management (Anon, 1985) estimated that Gujarat had 22 major and minor irrigation dams, with a total waterspread area of about 125,119 ha. The average productivity of these reservoirs was 9 kg/ha/year, while the maximum and minimum productivity was 32 kg/ha/year and 1.09 kg/ha/year respectively.

On the other hand, the State Fisheries Department has estimated that 296 reservoirs [Above 20 ha in waterspread area] are operating in the State. Their total waterspread area is estimated at about 1.93 lakh hectares. [Annexure-2]. The large reservoirs of the State are Dhari [10,700 ha], Kadana [16,600 ha], Panam [8980 ha], Kakrapar[44,200], Vallabhsagar-Ukai [52,000 ha], Madhuban [5,144 ha] and Shetrunji [6,734 ha.]. The details of the large/medium reservoirs of the State are given in Annexure-2. However, subsequently, the State Fisheries Department (Anon, 2000) has estimated that the State has 150 reservoirs, with an estimated area of 242, 205 ha., as detailed below.

Reservoir Category	Numbers	Area in Hectares
Less than 20 ha.	10	33
200 ha to 500 ha.	77	20,737
500 ha to 1000 ha.	28	19,328
More than 1000 ha.	35	202,107
Total	150	242,205

The district wise distribution of these reservoirs is given in the Annexure-3 (Anon, 2000).

The FAO of the United Nations which estimated the reservoir potentials of the country in 1995, observed that the State has over 700 small/medium/minor reservoirs and irrigation tanks with a waterspread area of about 2.9 lakh hectares (Sugunan, 1995). The details of these reservoirs/irrigation tanks are given in the Table at the end of this page.

Reservoir Management Policies: Several Reservoirs have been commissioned in the State ever since its formation in 1960. Primarily, most of them were constructed for irrigation purposes and managed by the State Irrigation Department. The fishing rights of all the watersheets in the State were vested with the State Fisheries Department in 1973.

The development and management of the reservoirs of the State have been regulated and carried out through various leasing/lending policies adopted from time to time. Initially, till the mid 1970s the reservoirs were bring exploited through outright auction system for 5 to 12 years by private individual/ agencies and co-operatives. About 30 reservoirs were entrusted to the State's Apex Fishery Cooperative [Gujarat Fisheries Development Corporation Ltd.]

The first ever reservoir leasing policy for fisheries purposes was drawn up by the State Fisheries Commissionerate in 1976, through a Government Resolution dated 6th July, 1976. This policy directed that Seasonal Tanks should be given on lease for a period of three years and perennial tanks of 10 to 200 ha should be leased out for 5 to 12 years. The upset prices were to be decided on the basis of the productivity, nearness to markets, input cost of the lessee and cost of physical improvement to the watersheet, if any. All the major reservoirs were to be given on a royalty of Re.1.00/kg of output. The Government also specified certain production/output formulae, basing on some assumptions of stocking and recovery rates.

This policy has undergone many changes and was replaced by new poli-

Category/Area	Irrigation Tanks		Reservoirs		Total	
	Nos.	Area(ha)	Nos.	Area(ha)	Nos.	Area(ha)
Small[<1000 ha]	561	44,025	115	40,099	676	84,124
Medium[1000-5000ha]	0	0	28	57,748	28	57,748
Large[>5000 ha]	0	0	7	144,358	7	144,358
Total	561	44,025	150	242,205	711	286,230

cies in 1982, 1990, 1992, 1995 and 1996. Very frequent changes in the reservoir leasing policy in the State has resulted in great confusion amongst the implementing agencies/officers and lessees and resulted in quite a large number of litigations. This has adversely affected the reservoir fisheries development and management in the State.

Frequent droughts and acute scarcity of water in the north Gujarat, Saurashtra and Kachchh regions, have resulted in great shrinkage of many reservoirs/irrigation tanks reducing them to mere seasonal water sheets. This has also added to the difficulties in the resources building, leasing, operations and effective management of the reservoirs in Gujarat.

Resource Building : Generally, no reservoir in Gujarat has a fish seed hatchery as its backward linkage, excepting Vallabh Sagar [Ukai]. Therefore, all the reservoirs - including the Sardar Sarovar - have to depend for its seed input on different hatcheries of the Fisheries Department/GFCCA situated at Wankaner, Ukai, Palan, Pipodra, Kosmada (Surat District), Lingda(Kheda District), Bhadarania (Anand District).

The State on an average produces 60 to 70 crore [600 to 700 million] major carp spawn in every monsoon. The year-wise production of major carp seed within the State for the past few years is given below:

Year	Spawn Production (Lakhs)
1989-90	2,190
1990-91	4,008
1991-92	5,196
1992-93	5,642
1993-94	7,461
1994-95	7,743
1995-96	6,943
1996-97	6,994
1997-98	6,713
1998-99	5,990
1999-00	4,691

These figures reflect only the seed production of the State/GFCCA owned Farms and do not include the seed production in the private sector farms in the State. It is learnt that about five seed farms do operate in the private sector in the districts of Valsad, Surat, Bharuch and Kheda and, on an average, they produce about 5,000 lakhs of (500 million) major carp spawn per annum.

The spawn is reared into fingerlings of about 40-60 mm length and these fingerlings are used for stocking in the reservoirs. Unfortunately, for want of adequate rearing space and limited water level in the ponds, the rearing operations are greatly affected and hence the net output of fingerlings do not exceed 3 to 4 crores [30 to 40 million] per annum. The State-owned farms do not have more than 10 ha. of rearing space each and hence they resort to seed rearing in the seasonal village ponds during the monsoon season. These constraints result in very poor recovery of fingerlings in spite of great effort and expenditure in the seed production operations of the State.

Thus, there is very acute shortage of stockable quantity and quality of fingerlings in the State. Also, it is feared that the size of the presently stocked seed is too small to survive in the large watersheets / Reservoirs. Further, it is worth mentioning here that for want of sufficient number of quality seeds, many reservoirs are understocked or poorly stocked.

In short, the main constraints retarding the present seed production and reservoir stocking are: a) Acute Shortage of rearing space for seed rearing; b) The size of the seed is too small for reservoir stocking and c) The quantity stocked is too meagre vis-a-vis the waterspread area.

These have resulted in a great reduction in the productivity/output of the reservoirs in the State. The average productivity of the reservoirs of Gujarat was 9 kg/ha/year, while the maximum was 32 kg/ha/yr and the minimum was 1.09 kg/ha/yr. (IIM, 1985). The present yield from the reservoirs is far too low in relation to their potentials.

Culture and Rearing in enclosures

It has, therefore, become necessary to overcome these constraints and enhance quality fish seed production and the rearing efficiency to maximize the yield of stockable seed. Requiring of advanced fry to fishing/early yearling size in enclosures for stocking the reservoir is one method to be adopted. In other words, the size of seed used for rearing in enclosures perhaps could help in a long way in this direction. The technology is already available in the country and these practices are in vogue in the Tungabhadra Reservoir. The experience of such reservoirs could be shared and the expertise of the agencies like the Central Institute of Freshwater Aquaculture [CIFA] and the Central Inland Capture Fisheries Research institute [CICFRI] could also be sought for in this regard.

Cages and Pens: The culture of fish in cages/pens of different sizes/material is in effect a confinement of large number of fish in small enclosures i.e. an intensive form of aquaculture. Two main factors enhance the potential of this form of fish farming. The system makes possible the raising of fish under high density in an aquatic environment unused or impractical for fish culture earlier. These aquatic environments are reservoirs, rivers, irrigation canals, mining pits, lakes etc.

The Culture and Seed Rearing in enclosures - like the Cages and Pens - has several advantages over the conventional (land based) fish seed rearing and fish culture in cisterns, raceways, ponds, tanks, etc. The land availability in the country has become very meagre even for the conventional agricultural pursuits, due to multifarious land uses. The opportunity cost of the land also has spiralled up on account of great demand in the non-agricultural sectors. Again, construction/creation of infrastructure for fish culture/fish farming/seed rearing has become highly very cost-intensive.

The constructed ponds/tanks/structures, being artificial, also have certain disadvantages as they involve consid-

erable costs in water intake/maintenance/ retention/replacement, maintenane of physical features, maintenance of optimum hydro-biological parameters, etc. The time over-run and cost over-run in the infrastructure development in the Government/Para Government sectors also are too prohibitive.

On the other hand, fish culture and seed rearing in pens/cages in a natural environment have many advantages over the land-based farming and rearing. The most important among them are: a) The System does not involve land utilization; b) The construction is cheap and easy; c) Involves very less time to creat/construct the cages/pens; d) Fluctutions in the hydro - biological parameters [like water temperature, pH, chemical properties, nutrients, etc,] are minimal Minimum stress of acclimatization of the seed/fish to different watermedia; e) Cheaper operative cost,as no power consumption, pumping cost, etc. are involved; f) Minimal handling of fish/Seed and the resultant mortality reduces need for water quality management.

The first ever attempt to rear fish seed in pens was made by the Co-ordinated Reservoir Project Centre at Bhavanisagar in Tamilnadu. However, the credit for large-scale pen rearing of fish seed in the reservoir should go to the Fisheries Department of the Thunga Bhadra Board controlling Tunga Bhadra reservoir. This agency has been rearing major carp fingerlings through pen culture in the Tungabhadra Reservoir and is carrying out seed stocking in the reservoir for the last two and odd decades.

The Cages : Cage culture is reported to have originated about 200 years ago in Kampuchea, where the Cat fish (*Clarius spp*) and the like were used to be kept by the fishermen in the bamboo cages in the basement of their floating dwellings, primarily for holding and vending purposes. (Hickling, 1962). This gradually became a system of culture, as the fish could withstand the crowded conditions in the cages and grew well feeding on kitchen leftovers (Ling, 1977).

A culture method in some parts of Indonesia is the use of anchored cages in the streams. Standing water cage culture is said to have originated in Japan. Philippines has had an extensive practice of milkfish farming for the past many years. These ancient/traditional practices deployed natural material like the bamboo for cage fabrication. Scotland presently produces over thousand tonnes of Alantic Salmon in cages. The massive commercial anchored/group cage culture with the modern material is of recent origin and is being practised in many countries, like Canada, Norway, Scotland, southern US, etc. from the mid seventies.

The available reports indicate that cage culture is of recent origin in India and was deployed for the first time for the culture of air breathing fishes in the swamps. The practice is reported to have been resorted for culture of major carps in the Yamuna and Ganga at Allahabad during early 1970s and for Carps and other fish in Bangalore in the 1980s Somewhere in the same time, they were reported to be used to replace ground nurseries for rearing fish.

The Pens : Pens, on the other hand, are reported to be of more recent origin and were being deployed for marine fish farming in Japan in the early years of the twentieth century and it subsequently spread over to China in the mid fifties for rearing carps in the freshwater lakes. However, pen culture was adopted on commercial scale in the Philippines for rearing Milkfish (Bandeng) in the late 1960s. Now a days, commercial pen culture for Milkfish, Grass carp, Silver carp and Tilapia is practiced in Philippines, Indonesia and China. In India, carp seed rearing was attempted in Bhavanisagar and Tungabhadra in 1978 for reservoir stocking. Pen farming/rearing have almost remained the same, excepting that the original wooden/split bamboos have been replaced by nylon/monofilament webbing.

Utilizing parts of reservoir areas for raising fish seed through pen rearing is a cheaper proposition than having cemented or earthen pond nursery. For the success of pen rearing in reservoirs, choice of suitable design is important. The ideal design should have: a). A gradually sloping bottom without obstruction; b) Protected from wave and wind action; C) A bottom to retain water of 5 to 6 ft. depth for a period of atleast three months; d) Easy accessibility

Generally, reservoirs are marked by sharp water level fluctuations to meet the demand of the agriculture and power sectors. Any sudden draw down exposes the pen. To avoid such situations, there has to be proper co-ordination with those in charge of reservoir water release for irrigation or other purposes. Reservoirs, which get filled up by July/August and retain that level till November are ideal for pen nurseries.

Pens are erected towards the shore before the reservoir gets filled up. The material used for pen erection may be a nylon/monofilament cloth or close bamboo matting. Nylon/monofilament cloth supported by a bamboo frame has been found to be useful. Once water enters the pen, nursery management practices, such as liming, maturing and supplementary feeding are resorted to for raising fingerlings of 75 to 125 mm in a period of three months of rearing depending on the availability of water.

The Coves and Bays: Reservoirs generally have widespread extensions from the main water body into which they open through a narrow mouth. These are generally referred to as Coves/ Bays. Coves are relatively shallow and protected from wave/wind actions.

These can be separated from the main reservoir by constructing artificial partitions. Depending on the size and depth of the cove, the culture system is chosen. In large and deep coves, cages can be installed for raising either fingerlings or fish. At the same time, the cove may be stocked extensively. The waste products and left-over feed from the cages help in fertilizing the cove, enhancing its productivity.

The Constraints: Pen/cage culture, however, have their limitations also.

Strong water currents, turbulence, wind and wave actions are not congenial as they may damage or dislocate the pens and cages. Therefore, their location is restricted to sheltered areas. Clogging of the cage/pen material and cutting of the screening material by crabs and other such animals are common problems. There is absolute dependence on artificial feeding, unless highly eutrophic water bodies are utilized. High quality balanced feed rations are essential for the fish stock and feed losses are possible. There can be interference from the natural fish population often. Small fish may enter the cages/pens and compete for food.

Designs & Erection: Fish pen designing and construction is easy and simple. Fish pens are of various shapes like circular, square, rectangular, etc. The pen should best be of square or rectangular shape for convenience of harvesting, using a drag or seine net.

The size of the pen depends on: a) Location; b) Depth of water; and c) Species of fish reared

For effective control, it is recommended not to increase the individual pen area to more than 500 sq.mts. For commercial operations, however, the sizes may be larger, ranging from 1 to 5 ha. in area. The height of the pen wall depends on the maximum water level during the culture/rearing period. There should be a reasonable free board (50 cm. or more depending on the wave action, jumping behaviour of the fish and the predator fish outside the pen) over the maximum water level. A portion (about 30 cm) of the wall should also go into the bottom mud to keep the pen wall secure.

The design of the pens, their configuration, duration of culture etc., may vary according to the water body. The water bodies for pen construction may be divided as:

a) Narrow rivers, irrigation canals, ox-bow lakes, etc; and b) Shallow reservoir margins or tanks.

Apart from the former, pens can be divided into a number of convenient sections by erecting partition fences across the narrow water bodies. There can be one to several pens in a series. Each pen will have two walls. But contiguous pens will have a common partition. The other two sides of the pen will be the river/ canal banks. In some creeks/ox-bow lakes, there may be a fence atleast on three sides, the shore being the fourth side.

The Scope/Need in Gujarat: The foregoing sections of this contribution indicate that the State of Gujarat has great potential to develop the reservoir fisheries of the State. The main constraint in this connection is the short supply of quality seed for reservoir stocking. This has come about because of very limited rearing space available in the State, especially in the north Gujarat, Saurashtra and Kachchh. The seeds are presently

ANNEXURE-1

District-Wise and Area-Wise Distribution of Reservoirs in Gujarat State

SR No.	District	21 TO 100 Ha		101 TO 500 Ha		501 TO 1000 Ha		1001 Ha.& Above		Total	
		NUMBER	AREA[ha]	NUMBER	AREA[ha]	NUMBER	AREA[ha]	NUMBER	AREA[ha]	NUMBER	AREA[ha]
1.	Kachchh	13	740.96	29	5,963.83	3	2,315.91	0	0	45	9,020.70
2.	Jamnagar	7	278.60	15	4,399.69	0	0.00	3	5,613	25	10,291.29
3.	Rajkot	6	409.74	18	3,848.80	4	2,604.68	6	10,779.26	34	17,642.48
4.	SUR.Nagar	4	200.56	9	1,801.43	3	1,802.76	1	1,913	17	5,717.75
5.	Bhavnagar	4	225.00	13	3,085.00	3	2,208.00	3	8,939	23	14,457.00
6.	Amreli	7	250.00	5	1,472.00	4	2,336.00	1	1,100	17	5,158.00
7.	Junadadh	2	158.00	10	2,784.00	3	2,194.00	1	1,582	16	6,718.00
8.	Panchmahals	40	2,084.18	5	1,106.04	5	3,730.65	3	7,279	53	24,199.87
9.	Surat	2	172.00	3	620.00	1	864.00	1	60,095	7	61,751.00
10.	Kheda	9	494.03	3	675.00	1	567.00	0	0	13	1,736.03
11.	Vadodara	11	508.50	5	750.00	1	579.00	1	1,904	18	3,741.50
12.	Bharuch	6	309.00	3	425.00	0	0.00	1	3,122	10	3,856.00
13.	Sabarkantha	3	177.00	2	640.00	0	0.00	5	10,928	10	11,745.00
14.	Banaskantha	0	0.00	2	614.00	0	0.00	1	4,144	3	4,758.00
15.	Valsad	0	0.00	2	489.78	0	0.00	1	4,368	3	4,857.78
16.	Mehsana	0	0.00	0	0.00	0	0.00	1	6,817	1	6,817.00
17.	Ahmedbad	0	0.00	1	296.00	0	0.00	0	0	1	296.00
TOTAL		114	6,132.57	125	28,998.57	28	19,202.00	29	1,38,583.26	296	1,92,763.40

ANNEXURE-2

Large And Medium Reservoirs of Gujarat

Name of the Reservoir	District	Area (ha)
Large Reservoirs		
1. Dharoi	Mehsana	10,700
2. Kadana	Panchmahals	16,600
3 Panam	Panchmahals	8,980
4. Kakrapar	Surat	44,200
5. Vallabhsagar [Ukai]	Surat	52,000
6. Daman Ganga [Madhuban]	Valsad	5,144
7. Shetrunji	Bhavnagar	6,732
Total		1,44,358
Medium Reservoirs		
1. Dantiwada	Banaskantha	4,047
2. Sipu	Banaskantha	2,568
3. Karjan	Banaskantha	3,677
4. Vanakbori	Kheda	2,086
5. Deo	Panchmahals	1,668
6. Hatmati	Sabarkantha	3,236
7. Meshwo	Sabarkantha	1,116
8. Vatrak	Sabarkantha	4,475
9. Guhai	Sabarkantha	1,713
10. Masum	Sabarkantha	1.310
11. Suki	Vadodara	2,904
12. Sankroli	Amreli	3,285
13. Ranghola	Bhavnagar	1,162
14. Sukhbadar	Bhavnagar	1,045
15. Sassoi	Jamnagar	1,648
16. Und	Jamnagar	1,730
17. Sani	Jamnagar	1,820
18. Amipur	Junagadh	1,581
19. Bhadar	Rajkot	4,400
20. Moj	Rajkot	1,203
21. Phophal	Rajkot	1,207
22. MachhuU-I	Rajkot	1,200
23. Machhu-II	Rajkot	1,396
24. Haji-II	Rajkot	1,439
25. Demi-II	Rajkot	1,023
26. Jyari-I	Rajkot	1,930
27. Brahmini	Surendranagar	1,914
28. Tapar	Kachchh	1,145
Total		57,928

Annexure-2 Contd..

ANNEXURE-3

District-Wise Distribution of Reservoirs in Gujarat State

(AS IN 2000)

SR No.	District	Less than 20 ha		20 to 500 ha		500 to 1000 ha		More than 1000 ha		TOTAL	
		NUMBER	AREA(ha)	NUMBER	AREA(ha)	NUMBER	AREA(ha)	NUMBER	AREA(ha)	NUMBER	AREA(ha)
1.	Ahmedabad	0	0	1	296	0	0	0	0	1	296
2.	Amreli	0	0	2	651	2	1,210	1	3,285	5	5,146
3.	Banaskantha	0	0	0	0	1	578	2	6,615	3	7,193
4.	Bharuch	0	0	4	634	0	0	1	3,677	5	4,311
5.	Bhavnagar	1	0	9	2,622	4	3,188	3	8,941	17	14,751
6.	Dangs	2	17	0	0	0	0	0	0	2	17
7.	Jamnagar	0	0	10	2,989	0	0	3	5,081	13	8,007
8.	Junagadh	4	0	13	3,907	3	1,895	1	1,581	21	7,383
9.	Kheda	0	0	0	0	0	0	1	2,086	1	2,086
10.	Kachchh	0	0	14	3,678	4	2,936	1	1,145	19	7,759
11.	Mehsana	0	0	1	277	0	0	1	10,700	2	10,977
12.	Panchmahals	0	0	4	950	5	3,695	3	27,249	12	31,894
13.	Rajkot	1	0	11	2,721	4	2,445	8	13,798	24	18,964
14.	Sabarkantha	1	0	3	936	0	0	5	11,850	9	12,786
15.	Surat	1	16	2	272	1	581	2	96,200	6	97,069
16.	Sur.Nagar	0	0	0	0	3	1,963	1	1,914	4	3,877
17.	Vodadara	0	0	1	130	1	567	1	2,904	3	3,601
18.	Valsad	0	0	2	674	0	0	1	5,144	3	5,818
	Total	10	33	77	20,737	28	19,058	35	2,02,107	150	2,41,935

produced in the rain-fed areas of South Gujarat, while the reservoirs are scattered very widely in the South, North and Central Gujarat, Saurashtra and the Kachchh regions, besides south Gujarat. A major activity of seed transportation/movement is involved in the reservoir seed stocking operations. Seed transporation is expensive and also entails in heavy mortality of seed on account of the scattered and far away locations of the reservoirs. It would, therefore, be advisable for the State to go in for the seed rearing within the available reservoirs, through pen/cage culture.

This system is in vogue in some of the reservoirs, like the Tungabhadra. The experience of other regions could be shared and the technical support available from the National Institutes could be taken advantage of for introducing this system in the State. This is especially needed in view of the coming up of the large reservoirs, such as the prestigious Sardar Sarovar.

References

1. ANON (1981): Marine Fish Marketing in India, Vol.II-Current Situation - Production, and Marketing (Maharashtra and Gujarat). Indian Institute of Management, Ahmedabad

2. ANON (1984): Master Plan for Fisheries Development in Gujarat State (1985-86 to 1994-95). Commissionerate of Fisheries, Gandhinagar.

3. ANON (1995): Training Programme on Cage and Pen Culture. Central Institue Freshwater Aquaculture, Peninsular Division, Bangalore.

4. ANON (1992): Environment Protection Programme through Fisheries Sector Development in Sardar Sarovar (Narmada) Project, Commissionerate of Fisheries, Government of Gujarat, Gandhinagar.

5. ANON (1999): Gujarat Fisheries Statistics. Commissionerate of Fisheries, Government of Gujarat, Gandhinagar.

6. ANON (2000): Gujarat Fisheries Statistics. Commissionerate of Fisheries, Government of Gujarat, Gandhinagar.

7. HICKLING, C.F.(1962): Fish Culture. Faber & Faber, London.

8. LING, S.W.(1977): Aquaculture in South East Asia - A Historical Review. University of Washington, Seattle.

9. NARAYANAN, K.R. & MOHAN CHANDY (1989): A Status Paper on the Fisheries of Gujarat. Commissionerate of Fisheries, Government of Gujarat, Gandhinagar

10. SUGUNAN, V.V.(1995): Reservoir Fisheries in India, FAO. *Fisheries Technical Paper* 345. Food & Agriculture Organization of the United Nations, Rome.

Building for NIO Regional Centre, Visakhapatnam

Foundation stone laid

Dr. Harsh K.Gupta, Secretary, Department of Ocean Development (DOD), New Delhi, laid the foundation stone for the proposed permanent building of Regional Centre of National Institute of Oceanography (NIO), Visakhapatnam, in Kirlampudi Layout of Andhra University Campus, Visakhapatnam on 18-12-2001. The function was presided over by Prof. J.M.Naidu, Registrar, Andhra University, Visakhapatnam and attended by Dr.Ehrlich Desa, Director, NIO, Goa and Dr.K.S.R.Murthy, Scientist-in-Charge of NIO, Regional Centre, Visakhapatnam and several scientists of NIO, NGRI, GSI, NSDAL, NSDRC, DS, NRSA, IIG, CMFRI, etc., and eminent faculty members of earth and ocean sciences of Andhra University.

Speaking on the occasion, Prof. J.M.Naidu assured all the help and cooperation from Andhra University to NIO during and after the construction of the building. He appreciated the closer links NIO has established with the University faculty.

Dr. Ehrlich Desa, saying that it was time that Regional Centre of NIO at Visakhapatnam to have its own building, he observed that with increased interest in ocean research activities in Bay of Bengal and Andaman Sea, Visakha Centre of NIO, the only one at present, on the east coast would continue to play a vital role in studies related to different aspects of this part of the Indian Ocean.

Dr.K.S.R. Murthy, Scientist-in-Charge of the Centre explaining the efforts made to get the site allotted, expressed his gratefulness to Registrar, Andhra University, for his help in the allottment of the site. He earnestly requested the University to allot some more area adjacent to the present site, so that a reasonably spacious office building could be erected which would be useful for collaborative research in ocean sciences between NIO and A.U. He expressed confidnece that the Secretary, DOD would continue to utilise Centre's capabilities in the development of different projects of DOD.

Dr. Harsh K. Gupta, before laying the foundation stone expressed appreciation of the generosity of the Andhra University in the allotment of space for earth and ocean science institutions in the State. He hoped that the Regional Centre would be able to carry forward multidisciplinary ocean research with its small but dedicated group. He gave an assurance to involve this group in National Projects of DOD

At the end of the function, mementoes were presented to Dr. Harsh K. Gupta, Dr. E. Desa and Prof. J.M.Naidu, by Dr. T.C.S. Rao, and Prof.D. Satyanarayana. Dr. Y. Sadhuram welcomed the gathering while Mr. Y.S.N. Raju proposed a vote of thanks.

Argulosis Infection in Carps and its Control Strategies: Preliminary Observations

Dinesan Cheruvat, C.K.Bharathan,N.N.Namboodiri, & T. Sidharthan
National Fish Seed Farm, Malampuzha, Palakkad, Kerala

Carp lice *Argulus* is a pathogenic crustacean belonging to the family Argulidae. These are ectoparasites of freshwater and marine fish, causing the disease known as Argulosis, which occasionally proves fatal to host fish. Like other ectoparasites they damage fish tissues by extracting haemolymph and other tissues, resulting in lesions on fish body, which cause further secondary attack by other pathogenic organisms. These are temporary facultative parasites which leave their host after sucking blood and tissue fluids, and then freely swim about for some time.

There was a serious attack of *Argulus* on the carp broodstock at National Fish Seed Farm at Malampuzha in Kerala during November 1999 to February 2000. While carp species like Catla (*Catla catla*), Rohu (*Labeo rohita*), Mrigal (*Cirrhina mrigala*), Grass carp (*Ctenopharyngodon idella*), Common carp (*Cyprinus carpio*) were moderately affected. In contrast, Rohu was affected severely. Most of the fish that died because of the infection are Rohu. Infestation by *Argulus* was first observed in the last week of November 1, 1999 and the fish began to die in the second week of December, 1999. 90% of the fish that died were Rohu. Later, secondary attack by fungus followed. The tissue from the affected area of the fish was examined under a microscope and mycelial body of the fungus could be clearly seen under the microscope.

Prophylaxis and therapy methods adopted in the beginning to control the parasites were unsuccessful due to various reasons. Infected fishes were separated and the pond bottoms, dried for four days, were treated with quicklime. The fish were given immersion treatment in weak Potassium permanganate, salt, formaldehyde solutions to disinfect the fish. These treatments killed the parasites but the cured fishes were again infected after 2-3 weeks. Use of chemical insecticides like Dichlorovos, Methyl Parathion were also not successful in the long run as reinfestation occurred after sometime. This led to adoption of biological control methods using indigenous fishes available in the area.

Feeding behaviour of fishes like Striped Barb (*Puntius fasciatus*), Ticto Barb (*Puntius ticto*), Slender Rasbora (*Rasbora daniconius*) etc. in aquaria has shown that these fishes feed on Argulus, both free living as well as those on the body of carps. Striped barb is found to be the most effective in feeding on *Argulus*. So a large number of these different species of fishes were collected from the Malampuzha reservoir and introduced in various ponds with fishes infested with *Argulus*. As a result, the disease started waning and mortality began to come down within two weeks of introduction of these different indigenous fishes referred to above. By end of February 2000 i.e., after one month of introduction of these small fishes the disease could be controlled completely. Interestingly the fishes used for biological control could also be used as ornamental fishes. Encouraged by this, further research work on rearing of some of these indigenous fishes is being continued at the farm.

Acknowledgements

The authors are grateful to the Director of Fisheries, Kerala and Mr. T.D. Velayudhan, Deputy Director of Fisheries (PM & E) for the their encouragement at every stage of the work.

Reference

SCHAPERCLAUS. WILHELM, 1986. *Fish Diseases.* Oxonian press Pvt. Ltd., New Delhi (English ed.,1991)

New Zeland Fish subsidies

According to a news item in *Samudra* Dec 2001 issue, New Zealand's Minister of Trade Negotiations, Mr.Jim Sutton is moving ahead to put an end to subsidies on fish subsidies, with the belief that this will help to manage the fish stocks in a sustainable and eco-friendly manner.

New Zealand has long been in the forefront in the efforts to get nations to agree on ending harmful subsidies in the fisheries sector, working through WTO. Sutton feels that ending fisheries subsidies in a critical environmental issue. He says that the scale of fishing industry subsidies is one of the reasons for global fish stocks reaching the present perilous state. It is felt that, once subsidies are ended the results would benefit countries who are striving to maintain fish stocks in a sustainable manner. The consumers can also buy the fish they want and the environment will improve.

RC (Aqua), MPEDA conducts Training on Ecofriendly and Sustainable Shrimp Culture

A five day training on eco-friendly, sustainable brackishwater shrimp culture was conducted at various Regional centres (Aqua) of MPEDA Kochi, Panvel, Thanjavur centres, and organised the training at Kandallore, Dhule, and Gosaba and Karaikal respectively during the month of september 2001. The training included a one day field trip and group discussions among farmers and students at various training centres.

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Investigation on a New Fish Taxa *Himantura* in the Saryu River flowing through the North-West Plains of Bihar, India

Ashok Kumar Jha
Co-ordinator, Industrial Fish and Fisheries and Head
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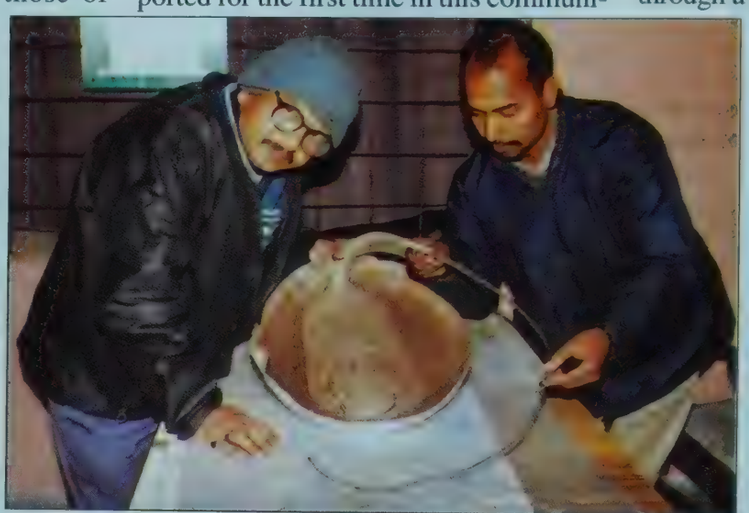
Several specimens of the Sting Ray were collected in the past from rivers Budhi Gandak, Bagmati, Koshi, and Ganga flowing through Saharsa, Purnea, and Khagaria districts of Bihar, by different authors who conducted surveys of fish fauna of these rivers. The morphometric characteristics of these specimen were identified by them as those of "*Dasyatis sephen*". Some variations were, however, observed in these freshwater forms, by the author, compared to the specimens of Sting Ray collected by different authors of India from marine and estuarine sources, as mentioned above. The variations related to length of snout, inter-orbital width, eye- diameter and, the length and diameter of their disc. It has been stated that these differences among the various specimens of the fish at source and the migrant ones (also amongst specimens of individual migrants) are the result of adaptation to enable the migrants to lead an adapted or acclimatised life in a better way in the new environment.

While the Sting Ray '*Dasyatis sephen*' was reported earlier, the Sting Ray of the genus *Himantura* is being reported for the first time in this communication, from the river Saryu or Ghaghra of Chapra district of Bihar. This Ray has not been reported to occur in any river till date from any State or Union Territory of India. The importance of this report is that, this Ray, a marine species, has an extended distribution into a lotic environment i.e., Saryu or Ghagra river indicating that through a migratory movement over years it has acclimatised itself to riverine conditions. The taxonomic position of the fish, as identified by the author, is as follows:

Class : Elasmobranchii
Order : Rajiformes
Family : Dasyatidae
Genus : *Himantura*
Species : *indica* (* proposed name in this communication)

[found in the Saryu river of north-west Bihar]

The main distinguishing feature between the genus



The Author (left) with *Himantura indica

Dorsal view of *Himantura indica*

Ventral view of *Himantura indica*

'*Dasyatis*' and '*Himantura*' is that the gill openings in the case of "*Dasyatis*" are equidistant, whereas in '*Himantura*' they are unequidistant. However, there are a few other differences too, mentioned elsewhere in this communication

River Saryu, after flowing through the plains of Uttar Pradesh, enters into the districts of Siwan and Chapra of Bihar State. The important town of Ayodhya is situated on the bank of the river Saryu in Faizabad district of U.P. This river has a historical background as it is considered sacred, being associated with Lord Rama and Gautam Rishi, husband of Ahilya. In addition to its religious overtones, the river is considered as the life line for the people living in and around Chapra district of North Bihar. North Bihar has a large number of rivers, streams, lakes, *chaurs* and *manns*. Unlike them, Saryu river becomes confluent with Ganga at Revelganj nearly 6 km west of Chapra town where both the rivers separate again and flow towards the east and become confluent with each other at Doriganj, nearly 12 km east of Chapra town. A survey has been undertaken for ascertaining the condition of habitat of "*Himantura*", an endangered fish popularly known as freshwater Gaint Sting Ray or Whip Ray. Although a large number of fish species are found in this river, this most interesting fish bearing the generic name *Himantura* spp., has escaped the notice of Ichthyologists as well as ecologists all along. This fish has been observed by the author in the catches from the river, although in a very few numbers, during and after monsoon in this region.

It is a paradox, however, that there is no evidence of any efforts made so far to unravel the mystery of its occurence in this region. This fish was not recorded so far either from freshwater rivers of this region or any other region of the country [Hamilton, 1822; Day, 1878; 1889; Hora, 1922; Misra,1949, 1952; Munro, 1955; Misra & Menon, 1951; Srivastava, 1968; Jayaram, 1981; Shrivastava, 1991]. Its presence in river Saryu however, has a long history, as ascertained from the traditional fishing community of the area. As a result of alteration in the ecological profile of the river as well as overfishing, this fish is now under the threat of extinction from this river. Therefore, measures to conserve *Himantura* spp of the river, as now reported, are essential not only for the posterity but also because the fish has economic significance. A grown up adult fish weighs 5 quintals or even more. The author entertains a fear that by the time scientific investigation of the population of the fish in the river is carried out, the fish may become extinct and may not exist for posterity to know about it.

Materials and Methods

A specimen of the fish, collected out of catches in a drag net was preserved in 8% formaldehyde solution and kept in a large container in the Zoology Laboratory at Ganga Singh College, Chapra.

Morphometric Features

The descriptions of various parts and measurements given hereunder are based on the study of specimens of similar size. The methods of measuring and counting and the terminology used were as given by Day (1878,1889) and Mishra (1961).

Disc: Almost rounded. Maximum diameter of the disc on the dorsal side across the pectoral fin at its anterior side is 45 cm. Length of the body excluding pectoral fin is 30 cm., while width of the body excluding pectoral fin is 20 cm. Dorsal surface is brownish grey in colour and the dorsal surface of the pectoral fin is darker than the dorsal portion of the body. Ventral surface is creamy white with tinge of red colour and without dark margin. Length of disc is 37.5 cm., which is about one third of the tail length i.e., 103 cm. On the dorsal surface of the disc, there is a median hump in the middle of the body. Three tubercles are present in the mid dorsal line. Both the anterior and posterior tubercles are four times smaller than the middle one.

Snout : It is a soft structure, pointed anteriorly. The length from the tip of the snout to the eye is 10 cm. Thus length of snout is one fourth of the disc length.

Eyes : The eyes are paired and large, not visible from below ventral surface. Periphery of each eye is 6 cm. and inter orbital space is 7.5 cm.

Mouth: Mouth is subterminal, located on the ventral surface. Distance of the mouth from the tip of the snout is 10 cm. Width of the subcrescentic mouth with two lobe like structures is about 4 cm.

Teeth: There are horny teeth on the upper jaw as well as lower jaw.

Spiracles: These are located at a distance of 13.5 cm from the tip of the snout as deep rounded holes, closed behind.

Gill openings: Five pairs of unequidistant ventral gill openings are present (hypotremata). Last pair of gill opening is the smallest. The distance between the first pair of gill openings on either side is 10 cm, second pair of gill openings is 8.20 cm, third pair of gill openings is 7.50 cm, fourth pair of gill openings is 5.75 cm, and fifth pair of gill openings is 5.00 cm.

Fins: In the anterior region of the body, the broadest parts of pectoral fin on each side measures 12.50 cm, and they unite anteriorly. The outer border of the dorsal fin appears rayed. Pelvic fin is also rayed, wide, flattened and rectangular, located at the base of the origin of the tail.

Tail: Tail is without a cutaneous fold, whiplike, very much thick at its anterior end. Two spines are located on right side of tail. Tail subcylindrical and thick anteriorly upto the origin of the spines and it tapers abruptly. Length of the tail is 103 cm.

Claspers: Paired claspers in male at the base of the tail have a length of 5 cm each.

Skin: Skin is smooth and its colour is darker over the pectoral fin than the upper portion of the body.

Intromittant organ: This is lodged in a cavity in the posterior part of the body on ventral side. Distance from the mouth upto the aperture of intromittant organ (penis) is 28 cm. The intromittant organ appears shrunken and is lodged in its cavity.

Weight: Five kilograms.

Discussion

No more information is available on *Himantura* in India. Work, however, had been done on *Dasyatis sephen,* an allied ray. In the case of *Himantura,* studied by the author, length of the disc is 37.5 cm, which is about one-third of the length of the tail. The total length from the tip of the snout to the tip of the tail is 148 cm. Misra (1969) has not described this fish. Day (1878) has mentioned length of tail 3 to 4 times to that of the body in the specimen of *Dasyatis* collected by him from seawater.

A comparative study of some of the morphological features of systematic value present in freshwater *Himantura* as now reported, and freshwater *Dasyatis* was made. The values obtained suggest that the two taxa significantly differ in their:(1) Length of disc in relation the length of tail; (2) Length of disc in relation to total length; (3) Eye diameter in relation to snout (4) Width of eye diameter interorbitally; (5) Placement of gills i.e., differences in distance between the two gill slits of each pair of gill openings and (6) Absence of skin fold over the tail.

Though the two taxa differ significantly, particularly in the size of disc, length of disc, length of tail, and distance between gill openings (equidistant in *Dasyatis* and unequidistant in *Himantura).* The variations being so marked they entitle the christening of this freshwater riverine Sting Ray, the subject of this communication, with a separate specific name under the genus *'Himantura'.*

Literature on the subject shows that '*Himantura* spp' has distribution between 25° N to 27° N latitude and between 84° E to 86° E longitude.

Srivastava (1968), Menon (1974), and Jayaram (1981)who conducted studies on rays have not mentioned about occurence of *Himantura* in rivers of India. Bleeker (1852) recorded the presence of *Himantura undulata* at Sydney aquarium. Sauvage (1878) recorded *Himantura oxyrhyncha,* Chabnaud (1923) recorded *Himantura krempfi*, and Compagno and Roberts(1982) recorded *Himantura signifer*, which is a white edged freshwater Whip Ray,in freshwaters of western Borneo, Kalimantran Barat, Indonesia. Monokolprasit and Roberts(1990) recorded *Himantura chaophraya* in Thailand.

As food, the flesh of this Giant Whip Ray or Sting Ray is considered as a delicacy and is reputed for its invigorating qualities. Spears of ancesters of the area are believed by local fishermen as tipped with caudal spines of this species. Even today its tail is used for making whip for use by horse riders in this region. Wounds inflicted by the spine of its tail are considered dangerous as this causes high fever.

To conclude, it is mentioned that the occurence of the genus "*Himantura*" from the freshwater of Saryu river is reported in this communication for the first time. As this ray may have further distribution in other rivers of India, the name of the species given by the author is *Himantura indica.*

Ackonwledgement

The author derived inspiration for this work from Dr. V.R.P.Sinha, former Director and Vice-Chancellor of Central Institute of Fisheries Education (Deemed University) Mumbai, Dr. B.C.Jha, and Dr. Utpal Bhowmick, Principal scientists, Central Inland Capture Fisheries Research Institute, Barrackpore, West Bengal for undertaking this study.

References

HAMILTON, F.B.(1822): "An account of the fishes found in the river Ganges and its branches", Edinburgh and London, pp. viii+405, 39 pls (Reprinted - 1981).

DAY, F.(1878): The Fishes of India : a Natural History of the Fishes of India, Burma and ceylon, Text including supplement, London 1:i-xx, 1:816; 2; 197 pls.

DAY, F.(1889): The Fauna of British India, including Ceylon and Burma. Fishes, London, 1:i-xviii, 1-548,164 figs:2:i-xiv,1-509, 177 figs.

HORA, S.L.(1922): Fauna of the Chilka lake, Fish. Part V-mem, Indian Mus 5: 739-769, text figs, 22-35.

SRIVASTAVA, G.J. (1968): Fishes of Eastern Uttar Pradesh, Vishwa Vidyalayam Prakashan, Varanasi, 1-xxii+163 pp.

MISRA, K.S.(1969): The Fauna of India and the adjacent countries 1. Elasmobranchii & Holocephali. Zoological survey of India, Calcutta pp. 1-xxiv, 1-276: 75 figs, xix pls.

MENON, A.G.K.(1974): A checklist of fishes of the Himalayan and the Indogangetic plains. spl. publ. No. 1, Indian Fisheries Soc., India, Barrackpore, 136 pp.

JAYARAM,K.C.(1981): The Freshwater Fishes of India, Pakistan, Bangladesh, Burma and Srilanka - A hand book, published by the Director, Zoological Survey of India, Calcutta.

MONKOLPRASIT and ROBERTS, (1990) Journal of Ichthylogy, vol **37**, No. 3; 203-208. Fig.1.November 30, 1990 (*Himantura Chaophraya* ; A new Gaint freshwater Stingray from Thailand).

SRIVASTAVA, M.P.(1991): Journal of Freshwater Biol. **3**(4): 281-2851 [1991].

ANON (2001) : Finding of New Fish Species claimed. *Fishing Chimes* **20** : 10-11.

Drugs & Chemicals Application in shrimp ponds: Norms Formulated

The Experts Committee set up by the Aquaculture Authority is reported to have drawn up a set of guidelines in respect of use of drugs and chemicals in shrimp farms.

The Committee which held its first meeting at Cochin on 17 December is understood to have prepared the norms related to use of permissible drugs and chemicals in shrimp hatcheries and in culture ponds, and during as well as their marketing and import.

It is learnt that the recommendations, to be submitted to the Union Agriculture Ministry and the Authority, would form part of the guidelines to be followed by shrimp farmers in the country for sustainable shrimp farming.

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Role of Microbial Biotechnology in Shrimp Larval Rearing

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The commercial success of industrial production of shrimp depends on the availability of quality fry to stock grow-out production systems. More attention to the quality and the competence of hatchery-produced postlarvae is needed to ensure better performance under grow-out conditions, with particular focus on bioaugmentation and microbial management of the various culture steps in the hatchery.

Bacterial diseases can completely destroy hatchery productivity for extended periods and they have been implicated to be one of the most devastating problems. The disease causing pathogens are generally of two types: primary pathogens which cause serious problems to animals even in low stress environment and opportunistic pathogens which normally exist within the natural environment of the shrimp larvae and are only capable of attacking a host whose normal defences are compromised by stress. Shrimp larval mortality is due to bacterial septicemia, which may be the result of either direct or indirect long-term stress. The hard exoskeleton forms a structural and chemical barrier to opportunistic or pathogenic microorganisms but they can gain entry into the body cavity through wounds or during moult. However, a detailed analysis of the possible origin of *Vibrio* bacterial disease outbreaks in the shrimp hatchery has been recently presented (Trinadha Babu *et al.*, 2001) and factors like husbandry and feed practices leading to ecological imbalance were also discussed.

Shrimp larvae live, eat, breath, grow, defecate and throw metabolic wastes into the culture medium. To this, excess feed adds up to the organic load leading to pollution and toxicity to larvae under rearing. This high organic load consumes the Dissolved Oxygen due to high Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) and causes stress to the larvae. Furthermore, larvae undergo stress due to factors such as inadequate physicochemical and microbiological quality of culture water, inferior nutritional status and high stocking densities. Such conditions lead to physiological and immunological stress on larvae, with a subsequent increased sensitivity to pathogens and cause mortality (Lightner, 1993). Since culture water is a major potential route for the entry of pathogenic bacteria into the shrimp hatcheries, care has to be taken to prevent entry of contaminated materials into culture water either during stocking, feeding, or water management. Seawater relatively devoid of toxic gases, environment of good bio-security and, congenial surroundings and neighbourhood are needed for healthy growth of larvae leading to better survivals. To control vibriosis and other diseases, it is important to follow the appropriate management techniques that improve sanitation or reduce culture stressors, since 'tomorrow is too late' for shrimp larval rearing.

It is possible to use several disinfectants namely sodium hypochlorite, formaldehyde, hydrogen peroxide and iodine in shrimp hatcheries. After disinfecting of water, the residues must be removed to prevent toxicity to the rearing larvae as this might again give an opportunity for the pathogenic bacteria to re-colonise. All the other water treatment methods such as ozonation and ultra-violet sterilisation have a similar problem. By means of these methods, pathogen bacterial counts can be reduced but cannot be totally eliminated. Nevertheless, presterilization of culture water is not always affective as opportunistic pathogens rapidly re-colonize cultures (Baticados and Pitogo, 1990; Alabi *et al.*, 1997). Therefore, it is difficult to obtain absolute sterility and this is almost impossible in commercial situations. Chemotherapeutic control of disease based on efficacy of available drugs appears to be limited because of the restricted tolerance of the shrimp larvae to drugs and the possible development of resistant strains of bacteria (Baticados *et al.*, 1990; Ruangpan and Kitao, 1992; Karunasagar *et al.*, 1994; Trinadha Babu *et al.*, 2000; Moriarty, 2001), ultimately leading to plasmid transfer between these bacteria and potential human pathogens. Interestingly, the biofilms formed by vibrios are reported to be protected by antibacterial agents making the treatments ineffective (Karunasagar *et al.*, 1996; Trinadha Babu *et al.*, 2000 & 2001) and these biofilms cause anoxic conditions, producing hydrogen sulphide and ammonia which again are detrimental to growing shrimp larvae. Thus it is evident that it is not possible to eliminate vibrios and other pathogens by use of sanitisers and chemicals. Therefore, chemotherapy in shrimp larviculture is ambiguous and it is doomed to be a failure, as it exacerbates the problems. Hence, alternative methods such as enhancing natural defence system, bioaugmentation and microbial management have been gaining in importance to prevent and control bacterial diseases in shrimp larviculture. However, it is generally recognized from successful efforts in land-based animal production industries that environmental management to reduce disease impacts is more reliable for increasing profitability than "pathogen" hunts for most diseases (Stoskopf, 1996).

It is a well known concept that microorganisms can be used to clean up the environment. The process of converting the environmental parameters to favourable levels using microorganisms is called 'bioremediation'. Incorporation of beneficial live microbes into shrimp larviculture tanks and balancing the ratio of beneficial and harmful microorganisms result in the suppression of pathogens to a very low concentration or even eliminated. Thus, managing microbial communities in aquabiotic ecosystems to control disease-causing organisms is otherwise known as 'Microbial Biotechnology'. These beneficial microbial products are popularly referred to as Probiotics (Pros - for; Bios - life) by Fuller (1997) and they include selected strains of bacteria, microalgae, fungi, etc. The probiotic concept consists of the controlled growth of an effective, natural microbial flora in the water used to culture shrimp larvae. The microbial flora can manipulate the species composition by seeding a large number of desirable strains of probiotics. The microbes generally are of the type that promotes the so-called exclusion process, which makes growth of pathogenic bacteria less probable. The additional effect is that larvae become accustomed to living within an array of microorganisms commonly found in shrimp ponds. The end result is the production of postlarvae with better-developed immune systems, which should allow them to adjust more easily and rapidly to the conditions in the commercial ponds. Presently more attention has been concentrated to isolate beneficial microbes that are capable of producing antibiotics and/or anti-microbial substances to inhibit growth of pathogens from seawater, sediments and gastrointestinal (GI) tracts of marine animals.

Bell *et al* (1974) postulated selective stimulation of marine bacteria by algal extracellular products. Scientifically, in addition to water flora, nutritional microbial properties of food affect the gut flora. It is therefore likely that the establishment of microflora in the intestinal tract of larvae is influenced by microalgae in the rearing water, either directly or indirectly by its ingestion affecting the colonization in the epithelium. In addition, algae may stimulate enzymatic synthesis and onset of feeding in young larvae. Specific polysaccharides present in the cell wall of the algae might stimulate the non-specific immune system in the early larval stages. The algae may also serve as food for the remaining *Artemia* in the culture tank and aid in water conditioning by stripping off nitrogenous substances or by changing the properties of the incident light through creating more shaded conditions. It is suggested that the extracellular metabolites and cellular protoplast of algal cells are able to perform bacteriostatic activity and competitive exclusion of the pathogens. Researchers have studied several such aspects including the bacterial interactions using *Tetraselmis* (Austin and Day, 1990); *Skeletonema* (Rico-Mora and Voltolina, 1995); *Chlorella* (Direkbusarakom *et al*., 1997); *Haematococus* (Darachai *et al*., 1998); *Spirulina* (Chand, 2000) and mixed diatoms (Lavilla-Pitogo *et al*., 1998). It was emphasised that ecological measures like application of selected microalgae to the shrimp larval rearing system help to produce N-acyl-homoserine lactone (AHL) mimics which prevent swarming and virulence in *Vibrio harveyi*. Nevertheless, higher growth rates have been observed with *Spirulina* incorporated diets as compared to control, along with possible effects in terms of disease resistance and immunity. *Spirulina* contains a rich source of carotenoids and *Haematococus* microalgae are known to produce astaxanthin carotenoid important for health, since it is involved in intracellular protection by stabilising cell membranes and improving health and immunology through the removal of oxygen free radicals. An extensively documented data stress on the vital role of carotenoids in the physiology and overall health of larvae. Hence, carotenoids are essential nutrients required to be incorporated in all aquatic diets. The potential algal biotechnological application to the control of virulent bacterial diseases in shrimp larval rearing is far reaching. Unlike antibiotics and bacteriocides, which kill bacteria leading to the selection for resistance in any survivors, the suppression of a behavioural trait such as swarming and virulence may not induce resistance selection, as bacterial numbers are not affected. In addition, no new compounds would be introduced into larval ecosystems as the present microbial components are marine algae. It is also suggested that successful manipulation of such benign microbes to compete with and exclude the potential pathogens is necessary to sustain ecological balance in the shrimp hatchery environment.

Recent observations have demonstrated that it is possible to protect shrimp against disease outbreaks by use of non-specific immunostimulants, when used orally, may act by altering bacterial flora in the gut rather than by acting directly on the immune system. These compounds are actually probiotic bacteria (selected strains of *Bacillus* spp.) acting by competitive exclusion and could become important tools in disease management in shrimp larviculture. Recently, attempts have been made to modify the microbial flora of larviculture systems using beneficial/probiotic bacteria. It has also been emphasized that probiotic bacteria secrete many enzymes that degrade slime and biofilms of vibrios. The enzymes breakdown not only the slime layers around Gram-negative bacteria but also utilize the organic matter and make nutrients unavailable to the growing vibrios. Thus the *Bacillus* bacteria compete with pathogens for food and space. This competition results in the elimination of potentially pathogenic bacteria and transfer of resistant genes. Further, selective habitat expansion can stimulate beneficial microbial process such as nitrification, while reducing processes such as sulphide production have negative effects on shrimp larval growth. Maeda and Liao (1994) noticed microbial processes in aquaculture environment and their importance in increasing the larval production. Garriques and Arevalo (1995) suggested that the use of *V. alginolyticus* as a probiotic could significantly increase growth and survival of *Penaeus vannamei* postlarvae by the competitive exclusion of potentially

pathogenic bacteria and can affectively reduce or eliminate the need for antibiotic prophylaxis in intensive larviculture system. Cui Jingjin *et al.* (1997) has reported that application of photosynthetic bacteria (*Rhodomonas* sp.) in rearing of *P. chinensis*, enhances the water quality thereby reducing fouling on the shell of the larvae and promoting better larval survivals. Recently, Rengpipat *et al.* (1998) isolated a *Bacillus* strain from the GI track of *P. monodon* broodstock. It was found that this *Bacillus* - fortified *Artemia* probiotic as a feed had significantly shorter development times and fewer disease problems than postlarvae reared without it.

Therefore, it is suggested that diatoms or beneficial bacteria could be applied as a biological control agent to promote better health, vigour and stress resistance in postlarvae. Bio-augmentation and the use of probiotics are significant management tools but their efficiency depends on understanding the nature of competition between the microbial strains. Nevertheless, probiotics principally inhibit the growth and decrease the pathogenicity of the pathogenic bacteria, enhance the nutrition of the aquacultured animals, improve the quality of the water and decrease the use of antibiotics and other chemicals; thus decreasing environmental contamination by the residual antibiotics and chemicals. This benefit of probiotics will be long lasting and the application of probiotics will become a major field in the development of shrimp larval microbial biotechnology.

Conclusions

The application of microbial biotechnology in shrimp larviculture, although not simple, is indeed feasible and necessary. Further research work needs to be carried out to properly document the fate of larval growth with microbial inoculations. A good starting point would be to perform stress tests on each batch of larvae produced with probiotics and follow with probiotic research in nursery and grow-out phases of production.

The ability to manipulate the microbial flora and ecology of larviculture systems through proper beneficial microbes is a viable alternative for growing shrimp larvae to continue as a sustainable animal husbandry practice in future. However, it is advantageous to shrimp industry to start with animals as healthy as possible not carrying the burden of prior infection.

In view of all this, we suggest that it is time for marine biotechnology firms to develop appropriate microbes to combat diseases, reduce post-ablation shock, inhibit *Vibrio* bacterial biofilms on spawners and postlarvae and also condition the pretreated seawater in the hatchery reservoir for use in shrimp hatcheries.

Unlike traditional chemotherapeutic methods that have been plagued by development of resistant bacterial strains, a natural remedy is the best ecofriendly measure in larviculture for challenging deadly diseases like vibriosis and others, now and in future.

Further reading

ALABI, A.O., YUDIATI, E., JONES, D.A. and LATCHFORD, J.W. 1997. Bacterial levels in penaeid larval culture. In: Flegel, T.W. and Mac Rae, I. H. (eds.), Diseases in Asian Aquaculture, Fish Health Section, Asian Fisheries Society, Manila, pp. 381 - 388.

AUSTIN, B. and Day, J. G. 1990. Inhibition of prawn pathogenic vibrio spp. by commercial spray-dried preparation of *Tetraselmis suecica. Aquaculture* **90**: 389-392.

BATICADOS, M.C.L. and PITOGO, C.L. 1990. Chlorination of seawater used for shrimp culture. *Isreali J.Aquaculture, Bamidgeh* **42**(4): 128 - 130.

BATICADOS,M.C.L., LAVILLA-PITOGO, C.R., CRUZ-LACIERDA, E. R., de la PENA L.D., and SUNAZ, N.A. 1990. Studies on the chemical control of luminous bacteria *Vibrio harveyi* and *Vibrio splendidus* isolated from diseased *Penaeus monodon* larvae and rearing water. *Dis. Aquat. Org.* **9**:133-139.

BELL, W.H., LANG, J.M. and MITCHELL, R. 1974. Selective stimulation of marine bacteria by algal extracellular products. *Limnol. Oceanogr.* **19**: 833 - 839.

CHAND, B.K. 2000. SPIRULINA: Wonder food. *Fishing Chimes* **20**(2): 28 - 30.

CUI JINGJIN, DING MEILI and SUN WENLIN. 1997. The application of the Photo-synthetic bacteria in the production of the shrimp larva culture. *J. Ocean University of Qingdao* **27**(2): 191 - 194.

DARACHAI, J., PIYATIRATITIV ORAKUL, S., KITTAKOOP, P., NITITHAMYONG, C. and MENASVETA, P. 1998. Effects of astaxanthin on larval growth and survival of the giant tiger prawn, *Penaeus monodon*. In: Flegel TW (ed) Advances in shrimp biotechnology. National Center for Genetic Engineering and Biotechnology, Bangkok, pp.117 - 121.

DIREKBUSARAKOM, S., PECHMA NEE, T., ASSAVAAREE, M. and DANAYADOL, Y. 1997. Effect of *Chlorella* on the growth of *Vibrio* isolated from diseased shrimp. In: Flegel T.W. and Mac Rae, I. H. (eds.), Diseases in Asian Aquaculture III. Fish Health Section, Asian Fisheries Society, Manila, pp.355 - 358.

FULLER, R. 1997. Probiotics2 Applications and practical aspects. 1st ed. London : Chapman & Hall, 211 pp.

GARRIGUES, D. and AREVALO, G. 1995. An evolution of the production and use of a live bacterial isolate to manipulate the microbial flora in the commercial production of *Penaeus vannamei* postlarvae in Ecuador. In: Browdy, C.L. and Hopkins, J.S. (eds.), Swimming through Troubled Waters, Proc. of the special session on shrimp farming, Aquaculture '95. World Aquaculture Society, Baton Rouge, Louisiana, pp.53-59.

KARUNASAGAR, I., OTTA, S.K. and KARUNASAGAR, I. 1996. Biofilm formation by *Vibrio harveyi* on surfaces. *Aquaculture* 140: 241 - 245.

KARUNASAGAR, I. PAC, R. MALATHI, G.R. and KARUNA SAGAR, I. 1994. Mass mortality of *Penaeus monodon* larvae due to antibiotic resis-

tant *Vibrio harveyi* infection. *Aquaculture* 128: 203 - 209.

LAVILLA - PITOGO, C.R., ALBRIGHT, L.J. and PANER, M:G. 1998. Will microbial manipulation sustain the ecological balance in shrimp (*Penaeus monodon*) hatcheries? In: Flegel TW (ed.) Advances in shrimp biotechnology, National Center for genetic engineering Biotechnology, Bangkok, pp. 185 - 192.

LIGHTNER, D.V. 1993. Diseases of penaeid shrimps, In: Mc Vey, J.P. (ed.), CRC handbook of Mariculture, 2nd ed. Vol I, Crustacean Aquaculture, CRC Press, Boca Raton, FL. pp.393-486.

MAEDA, M. and LIAO, I.C. 1994. Microbial processes in aquaculture environment and their importance for increasing crustacean production. JARQ **28**(4): 283 - 288.

MORIARTY, J.W.D. 2001. Hazards of antibiotic use in Aquaculture. *The Advocate* **4** (5): 15 -16.

REGNPIPAT, S., RUKPRATANPORN, S., PIYATIRATITIVORAKUL, S. and MENASVETA, P. 1998. Probiotics in Aquaculture: A case study of probiotics for larvae of the black tiger shrimp *(Penaeus monodon)*. In: Flegel, T.W. (ed.), Advances in shrimp Biotechnology, National Center for Genetic Engineering and Biotechnology, Bangkok, pp. 177 - 181.

RICO - MORA, R. and VOLTOLINA, D. 1995. Bacterial interactions in *Skeletonema costatum* Cleve (Bacillariophyceae) cultures. *Rivista Italiana Aquacoltura*. **30**:105 - 109.

RUANGPAN, L. and KITAO, T. 1992. Minimal inhibitory concentrations of 19 chemotherapeutants against *Vibrio* bacteria of shrimp *Penaeus monodon*. In: Shariff, M., Subhasinghe, R. P. and Arthus, J. R. (eds.) Diseases in Asian Aquaculture I, Fish Health Section, Asian Fisheries Society, Manila, pp.135-142.

STOSKOPF, M.K. 1996. Comparison of aquaculture and other animal production medicine strategies in the United States of America. In: Main K. and C. Rosenfield (eds.) Aquaculture Health Management Strategies for Marine Fishes. The Oceanic Institute, Honolulu, Hawaii, pp. 91 - 100.

TRINADHA BABU, B., PRABHAKARA RAO, Y. and MADHAVI, R. 2000. Virulent *Vibrio* problems in shrimp aquaculture. *Fishing Chimes* **20**(8): 49 - 52.

India elected as Co-Chairperson of IOTC

The Indian Ocean Tuna Commission (IOTC) during its Sixth Session held in Seychelles from 10-14 December, 2001 elected unanimously Mrs. Nirja Rajkumar, IAS, Joint Secretary (Fy) to the Govt. of India, Ministry of Agriculture, Department of Animal Husbandry & Dairying, New Delhi as Co-Chairperson of IOTC. She was however, later tranferred and Mr. P.K. Pattanaik, IAS has taken over as Joint Secretary (Fisheries). The members of the Commission include the representatives of coastal states of the Indian Ocean, besides the distant water fishing nations participating in tuna fisheries of the region, viz., China, France, Spain, European community and U.K.

The Fourth Session of the Scientific Committee of the IOTC was held at the Victoria Conference Center in Victoria, Seychelles from 4 to 7 of December, 2001 prior to the Sixth Session IOTC. The Scientific Session was attended by thirty three delegates from thirteen IOTC member countries as well as six observers from members of FAO and other UN agencies and national organizations. Dr. Chien Chung Hsu and Mr. Yu Yi Huang of Taiwan, China attended as invited experts. From India, Dr. V.S.Somvanshi, Director General, FSI attended the scientific committees session. The Scientific Committee was chaired by Mr. Renaud Painet of France.

The Scientific Committee reviewed the progress of work carried out by various Working Parties during the year 2001, namely i) Working Party on data collection and statistics ii) Adhoc working party on methods iii) Working party on tropical tunas and iv) Working party on bill fishes.

The Management recommendations made during 4th session of the Scientific Committee are (i) A reduction in the catches of big eye tunas by all gears to the MSY level with immediate effect. A time area closure and effort control for Purse-seine fishery and a catch quota/ effort control on the long line fishery (ii) No further increase in catch and effort for sword fishing until stock assessment in made from the prresent area of operation of the fishery.

Based on the recommendation of the Scientific Committee, various issues relating to Tuna stocks in the Indian Ocean and related activities to be undertaken by the Commission during next year were discussed at the Sixth Session . As a follow up to the various issues that emerged from the Sessions of the Scientific Committee and IOTC held during first fortnight of December 2001, some of the important matters have been identified. The matters identified for immediate action to be initiated by India (FSI) include a scheme on tagging of tunas, tuna statistics and data collection, investigations on the impact of industrial fishery of tunas on artisanal tuna fishery.

Winter School on Microbiology and Biotechnology

Prof.D.M.Thampi, Fisheries College, Kochi inaugurated the winter school on "Advances in Microbiological and biotechnological methods for detection of pathogenic micro-organisms and their toxin in fish and fishery environments" at CIFT, Kochi. He emphasised the role played by CIFT in improving seafood quality, particularly for export.

Altogether 30 candidates participated in the winter school which ended on 25th Nov, 2001. The winter school was organised by Microbiology, Fermentation and Biotechnology Division of CIFT.

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Aquaculture in Participatory Integrated Watershed Management : A Need for Sustainable Development

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Dehradun- 248 195

Watersheds play a key role in the development of inland fisheries. They provide water to running water systems such as rivers and streams (snow and springfed) irrigation channel networks rainfall-runoff, surface and sub-surface water harvesting tanks, off-stream ponds, irrigation channel networks, rservoirs etc. Which are the home for fish stocks that are captured by operating different types of nets. Whatersheds also provide water supplies to lentic resources such as tanks and ponds and lakes and resrvoirs which are capture-cum-culture resources.

Watersheds have the potential to provide further opportunities for the development of culture fisheries. This potential can ben harnessed by diverting surplus waters of watersheds that go waste now for development of culture fisheries. This can be done by integrating culture fishing system as part of watershed development.

Participatory Integrated Watershed Management (PIWM) has been taken up in the country in recent years. PIWM has provided overwhelming impetus to several water-dependent activities, particularly in respect of rural development. Watershed may be defined as a naturally delineated area that is drained by particular stream, system or a body of water PIWM aims at management of watersheds by way of adopting a holistic and multi-disciplinary approach that takes into account ridge to valley treatment with people's participation PIWM undertakes development of water resources, in various ways. These include harvesting of rainwater, harvesting the potential of excessive runoff, promoting water conservation, taking care of Water Harvesting Structures (WHSs) and development of manpower to manage these activities as prime intervention points along with many other site-specific treatments. The developed water resources provide basic opportunities for fish farming and associated benefits.

Importance of Aquafarming in Watershed Management

Aquafarming is an activity that deals with culture of aquatic organisms such as finfish, shrimp and prawn, molluscs etc., under controlled aquatic environment. It aims at realising optional benefits from a culture resource on an enduring basis. Water resources under watershed management programme as well as aqua species for culture in them are diverse. These have to be matched according to the conditions of existence and choice of farmers out of the various alternatives available. Aquaculture activities have viable puissance to alleviate poverty, provide balanced diet and ensure livelihood securities at national level, particularly in Asia. They possess immense potential to positively contribute to integrated watershed management efforts (Fig. 1 and 2) and upgrade the system in a manner that would contribute to a higher level of proteinacious food production. In essence, aquaculture has many positive features which entire this activity for to be considered as an active sub-sector under watershed management programmme. These are:

1. It is an enterprise that any person who has farming spirit and some exposure to aquatic science and fish culture can practice. It carries practically no risks and at the same time yields good returns.

2. Fish flesh is less expensive, protein-rich and contains most of the essential nutrients including Poly-Unsaturated Fatty Acids (PUFA) and vitamins required by human beings to balance their diet. It is easily digestible wholesome fish flesh consumption eliminates food related medical problems.

3. Being relatively cheaper than other protein foods, it has the potential for being consumed as a nutritious food by almost all sections of the society.

4. Fish can be harvested in numbers as needed to serve as fresh food has part of balanced diet, without entailing the need for refrigerated observation before hand. This feature helps in areas where there are no facilities of power supply, refrigeration or of ice supply.

5. Fish farming reduces fishing pressure

Fig 1: Fish Haul from a Watershed Pond

Fig 2: Fish Yield from a Rain-fed Pond

in wild waters such rivers and streams, and in ther sea, for the reason that it can generate supplies against demand with a good measure of certainty of harvest unlike fishing in wasters, the results of which are not predictable. This diversion reduces fishing pressure on endangered species and minimises bio-diversity losses.

6. Integration of fish farming in watershed management provides greater opportunities for many sub-sectors like agriculture, horticulture, animal husbandry, poultry, agro-estology, forestry, water-mills and such others in one form or another. For example, the exchanged water from fish ponds, is often rich in nutrient content because of the impact of fertilisation pond waters, fertilisation of feed that would remain uneaten by fish under culture and of faecal matter dropped by them and excreta of other aquatic biomass. Additionally, pond dykes can be utilised to raise vegetables, horticulture crops, grass for cattle and other shallow rooted Multi-Purpose Trees (MPTs). Here, integrated use of land, water, agricultural and animal wastes, labour and other infrastructures is internalised in the real sense of holistic approach. Watershed management practices like reclamation, renovation, waste recycling and resource optimisation would improve opportunities for potential resource use in fish farming.

7. Aquaculture enhances employment opportunities as it is a labour oriented enterprise that absorbs work forces from varied sections of the society including women, men, school drop-outs and landless labourers for various activities such as pond preparation, stocking with seed, feeding the fish under culture, watch and ward, harvesting, transportation of harvested produce and its marketing.

8. Initiatives to develop aquaculture under watershed programmes would generate several subsidiary and associated activities like fish hatcheries, for spawn production, nurseries, for raising spawn to fry/fingering stages for stocking fish ponds, and seed-banks, on one hand, and ice plants and the production of fish containers, feed mills for feed production etc., enterprises for providing to needed supplies and services to farmers (pond medicines, feeds, fertilisers etc) would strenthen themselves to meet the increasing demand or new ones will come up. More of aqualabs would come up. There will be employment generation contributing to economic well being of weaker sections of society.

9. An aptitude towards fish farming and eventual entry into the activity creates environmental awareness and increased ecological literacy rate among the farmers concerned. In the process of gaining experience in fish farming, farmers/entrepreneurs come to know about fundamental aspects of fish farming. These viz., the food chain in a pond and other related aspects. They would also learn about other essential aspects such as; fish as consumers of plankton, about microbes as decomposers; about pond ecology, pond preparation as a prelude to fish culture, about importance of fertilisation of ponds, feeding of fish, biomass enhancement etc., knowledge of these aspects equips farmers/entire preneurs to conservatively utilise the resource concerned, to preserve ecological conditions and their interlinkages, about primary producers, (Phytoplankton), secondary producers, (Zooplankton).

10. Fishponds or watershed ponds act as traps to store and redistribute eroded soil and nutrients from catchment or up-slope regions to source.

11. Development of fish ponds and fish farming promotes wetland ecology, wildlife and aesthetics of the area fishponds can also be bird sanctuaries, reserves of aquatic organisms and also pools of endangered or vulnerable species. If managed properly, fish ponds provide water, food and shelter for a variety of wild and aquatic species, while providing fish crops.

12. Fish farming in WHSs can promote local sport fishing, recreational farming and attract villagers for pond-based activities like bathing and boating, as a diversion from routine chores. Though attractions of this kind, villagers may develop a long-lasting attachment towards ponds for their responsible and sustainable utilisation.

Virtually, development of WHSs and fish farming therein has many inherent advantages. First of all, fish farming in WHSs it doesnt require additional labour, water and pond, as they would be have been already developed under the essentials of watershed management. Water in developed WHSs gets enriched with necessary nutrients like excreta of fish and other aquatic organisms, fertilisation and feeding, generated by fishes during farming activity. So, integrated agriculture crops that receive this enriched water from WHSs tend to require minimal dosage of fertilisers or no fertilisers at all provide higher profits to the farmer. As multi-purpose water resources, pond and manpower have already been developed under watershed programmes, the need for inclusion of aquaculture to promote fish production under the programme has been highlighted in order to supplement production and earning higher returns with least additional investment. Fish farming will be an incentive for resource conservation as it is a non-consumptive water use proposal. Fish do not consume water and the water loss in developed water resources could be due to other phenomina like seepage, evaporation and irrigation.

Glimpses of Water Management and Fish Production Techniques

Despite many inherent benefits of aquaculture in watershed ponds, stringent water management may not be possible as water source is mainly from limited rainfall-runoff in the ponds. Water level may go down below critical point during summer or during low rainfall period and this restricts aquacultural productivity. However, the conjunctive use of ground water or irrigation canal water if available may pre-empt the problem greatly. Integrated use of water for life-saving irrigation or others needs to strike a compromise to accommodate aquacultural as it would require a minimum water level of 0.8 m or more according to species, density, biomass and location. In fact, a co-ordination and compromise between agriculture use and aquacultural need to be arrived to maintain a minimum dead level in ponds to favour optimum production from both. The Watershed:Pond Ratio (WPR) should be properly matched to harvest potential water yield for productive and conservative use. Normally, 7 - 30 ha of watershed may provide 1 ha-m water depending on the features of watershed, rainfall and climate. If water yield is more, series of ponds may also be proposed to augment conservative production. For effective pond and production management, appropriate design, orientation, size, shape and capacity of ponds accounting quantity, quality and period of water availability, demands and losses of water under watershed management are indispensable.

Effective watershed treatment and man-

Table-1. General Requirements for Fish Farming under Watershed Management

S.No.	Requirements	Specifications
1.	*Land-Water*	• 7-30ha watershed/catchment for 1 ha-m water • Volume runoff/Pond Volume: Humid = 3 Semiarid = 4 • (E + S) -P = 25 cm/yr (E= Pan evaporation(0.7;S=Seepage;P=Precipitation) • Rainfall seasonality (consecutive days without significant rainfall)=5-25 days (more days is acceptable, if alternate source water available) • Vegetative cover in Watersheds = 70-100% (Less cover is permissible, if conservation measures are established) • Depth to water table => 75 cm • Water source: surface, sub-surface water harvesting, snow and spring fed streams and runoff.
2.	*Suitable species and fish seed rate*	• 4 - 10 Seeds/m3 stocking density. • Seed price - Rs.75 - 125/1000 seeds. • Species - Indian and exotic carps (catla, rohu, mrigal, silver carps, grass carps, magur, common carps), air breathing fish (live fish), catfish, prawns, shrimps and cold water species like mahseer, trouts, Schizothroax spp.
3.	*Feed*	• Good natural feed and water management. • Artificial supplementary feed. • Ingredients - rice bran, wheat flour, oil cake, tapioca powder, fishmeal, agricultural, slaughter (for carnivores like magur and Channa spp.) and household wastes. Normally, rice barn and oil cakes, 1:1 ratio would suffice supplementary feed for carps in composite culture. • Local preparation at pond itself as there is no any com mercially prepared pellet feed for freshwater fishes in most areas.
4.	*Labor*	• For feeding, soil and water testing, watch and warding, harvesting and marketing. Of course, if watershed ponds are located far-off from local settlement, chance or intuition for poaching may be remote. Further, through the participation of villagers and other stakeholders, social fencing need be created to ward off socio-cultural problems and control or regulate through penalty for violators of norms.
5.	*Fish farming*	• Low management-intensive, extensive type of carp, techniques prawn, shrimp, catfish and live fish farming.

agement is essential to reduce problems like eroded soil reaching a pond to create turbidity, reduce capacity, entry of light and primary productivity in the watershed ponds. As water quality is important for fish production, turbidity reduction through silt detention structures at inlets, monitoring for pH, dissolved oxygen, water-colour, temperature, ammonia and other pollutants are to be regularised for assured production. Further, screening with suitable mesh at inlets and outlets is essential to screen out weed fish sediments and other allochanthous materials and to prevent the escape of stocked biomass respectively to avoid problems at later stages problems and production loss. Soil-water quality management, scientific fish farming, programmed harvest and post-harvest management, input-output planning, store management and record keeping are essential for successful fish farming in watershed ponds as part of watershed programme.

Watershed-based aquaculture can be managed through minimum inputs for additional benefits. The general requirements for the watershed-based aquaculture are given in Table 1. Low input extensive types of fish farming, composite carp culture and polyculture of fish and prawn are some of the suitable fish production techniques under watershed mission. Normally, fish feeds include natural and supplemental or artificial feeds. Natural fish feeds include phytoplankton, zooplankton, benthos, aquatic insects, microphytes, macrophytes and detritus mass for different species. Natural feeds can be developed through external fertilisation. Pond fertilisation to induct primary producers, (Phytoplankton), for natural feed of zoolplankton, fingerlings and fish is achieved through inorganics like urea, super phosphate and organic fertilisers like Farm Yard Manure (FYM), animal wastes etc. Pond fertilisation may not be necessary if runoff comes through nutrient-rich agricultural fields, as incoming runoff would bring sufficient nutrient load. Artificial fish feeds can be prepared using locally available agricultural and house-hold wastes along with few other essential nutrients like vitamin and mineral mix for high density production with intensive management. Commercial pellet feeds are also available in the market for enhanced fish production.

Conclusion

In all, water development for and aquaculture in WHSs, along with related activities to minimise wastes and maximise profits in integrated modes are potential interventions for the development of watersheds and their resources. Presently, both the concepts of watershed management and aquaculture needs appropriate interaction to augment environmental and social prosperity. Sustainability of the natural resources requires inter-disciplinary development including capture fisheries and aquaculture through scientific and engineering principles. Towards this, targeted training, out-reach programmes and awareness campaigns along with programmed and co-ordinated research to characterise the interface between aquaculture and other agricultural sub-sectors under watershed mission are the need of the hour.

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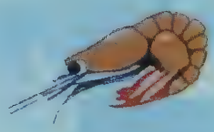

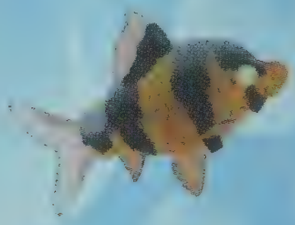

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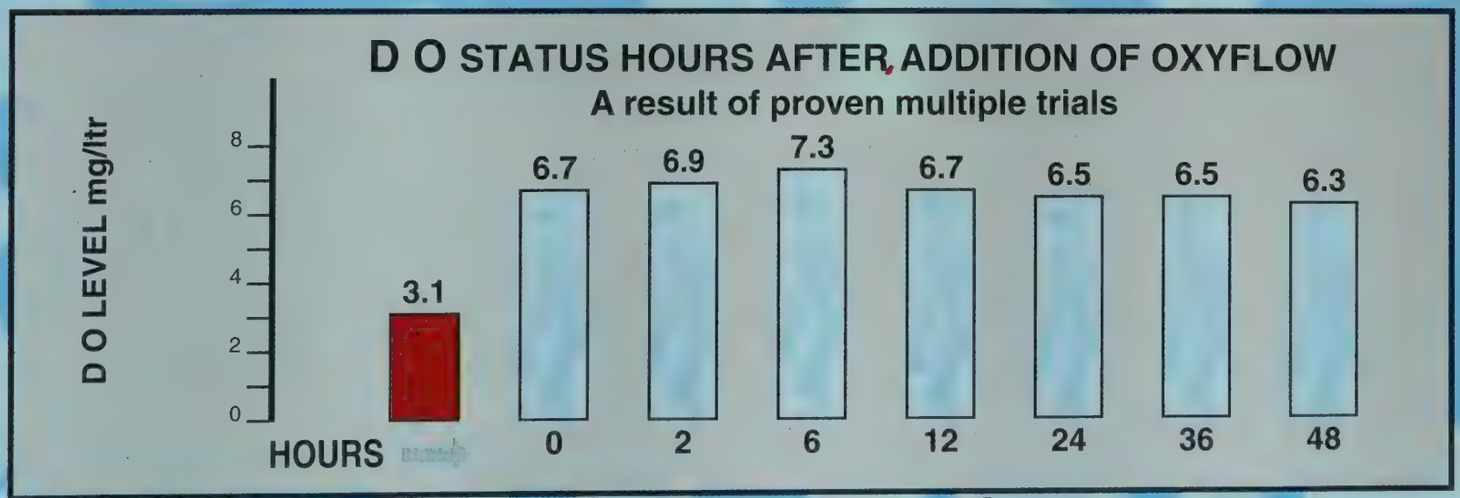

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Mass Breeding of the Striped Murrel, Induced through 'Ovaprim'

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The striped murrel *Channa striatus,* commonly called snakehead, is an obligatory air-breathing fish, native to Asia and Africa (Ng and Lim, 1990). Murrels are well known for their taste, high nutritive value, and recuperative and other medicinal qualities and is recommended as a convalescence diet. (Khanna, 1978). They are cultured in Thailand, Philippines, Taiwan, and in India. The attributes that qualify the fish as a desirable species for culture include high market value, rapid growth, amenableness to high stocking density and ability to utilise atmospheric air for respiration even when there is depletion of dissolved oxygen in pond water (Sampath, 1985). Commercial murrel culture mostly relies on captured fry from the wild. The fry are trained (after capture and transfer to a farm) to accept formulated feed consisting of fish paste, rich bran and wheat flour (Diana *et.al* 1985) or on fresh chicken intestine (Josemon *et.al*.1992). Murrels spawn naturally during south-west monsoon (June-August) and also in north-east monsoon (October-December) in flooded rivers and ponds in India. The major constraint in the culture of murrel is the non-availability of quality seeds from the wild when there is failure of monsoons and scarcity in the availability of mature broodfish. Moreover, there is no established murrel seed supply centre anywhere in India. Hence it is expedient to introduce an enduring system of producing seed of the fish through induced breeding, as an alternative to the present unreliable dependence on wild seed collections, for supply to fish farmers engaged in murrel culture. In this context, an experimental study of mass breeding of *C.striatus* in an earthen pond has been conducted by the authors.

Fig 1 : Ovaprim being injected into *Channa striatus*

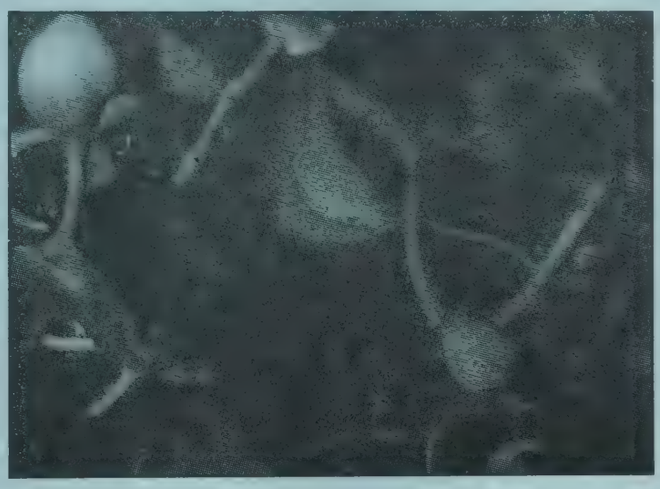

Fig 2 : Egg Cluster on *Eichhornia crassipes*

Materials and Methods

On the basis of external morphological features (Parameswaran and Murugesan, 1976), sixteen healthy *C.striatus* (10 males:6 females) were selected out of striped murrel brooders grown in a stocking pond on August 25, 1998, a day in post-southwest monsoon season. They were administered a single intramuscular injection of Ovaprim (Syndel Laboratory Ltd., Canada) at a dosage of 0.5ml/kg body wt., (Haniffa *et al* 1998) (Fig.1). These injected broodfish were introduced into the breeding pond (50 x 25 x 3 ft) and allowed to mix with the uninjected broodfish (70-80 in number, 655-980 g weight each). Aquatic macrophytes like *Hydrilla verticillata* and *Eichhornia crassipes* were introduced into one corner of the pond to facilitate hiding by the fish. After spawning, fertilized eggs (Fig.2&3) were collected from the breeding pond using a fine-meshed net. The collected eggs were then transferred into rectangular glass aquaria (25 lit capacity) for incubation and larviculture. Number of eggs was estimated volumetrically (Lagler, 1982). Fertilisation and hatching rates were estimated based on 100 eggs placed in a 500 ml beaker. Hatching rate was determined as the percentage of eggs hatched from the fertilized eggs and the hatchlings were reared in glass aquaria (Fig.4) and cement tanks (3 x 1 x 1 m). The hatchlings were fed initially on plankton soup collected from CARE culture ponds, followed by mosquito larvae, and sliced *Chironomus* larvae, weaned and finally fed on chicken intestine-based formu-

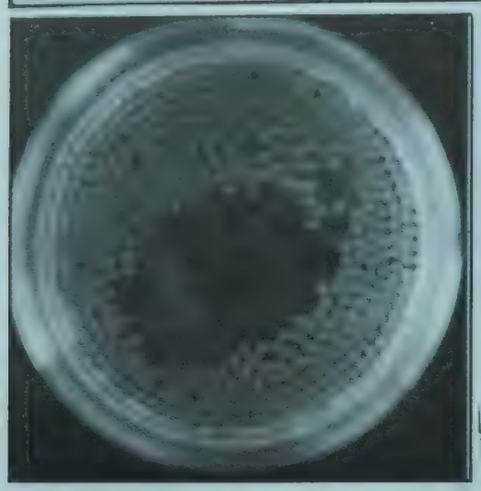

Fig 3 : A view of eggs

Fig 4 : Fingerlings in an aquarium

lated semi-moist diet.

Results and Discussion : Results of the induced spawning trials conducted are summarised in Table 1. Spawning was noticed on 28th August 1998, 72 hours after injection. Subsequent spawnings were noticed till 10th November 1998. Total number of eggs collected was 10,880 of which 70% were fertilized eggs. The hatching rate varied from 60 to 90%. The recovery of hatchlings varied between 3,600 and 6,048.

Table.1. Mass breeding of *Channa striatus* by Ovaprim (0.5ml/kg body wt.)

Experiment Date	*No of fishes*		*Fish weight (g)*	*Date of spawning*	*No.of eggs*	*Fertilisation (%)*	*No.of fertilised eggs*	*Hatching (%)*	*No.of Hatchlings*
	Male	*Female*							
25.08.1998	10	6	655-980	28.08.98	10,800	70	7,560	80	6,048
				18.09.98	5,650	85	4,802	75	3,600
				30.09.98	7,600	60	4,560	90	4,104
				09.10.98	10,670	80	8,536	60	5,121
				10.11.98	9,660	68	6,568	85	5,583

Banerjii, (1974) and Parameswaran and Murugesan, (1976) attempted hypophysation to induce breeding in murrel, *C.punctatus, C.orientalis, C.striatus* and *C.marulius* in laboratory conditions but the success was limited. In the present study, synthetic hormone (Ovaprim) injection was administered only once to 10 males and six females of channa striatus but spawning was noticed five times. Hence it is possible to suggest that there was simulated spawning by a few uninjected *C.striatus*, kept along with injected ones. According to Murugesan and Kumaraiah (1984), in addition to spawning by injected individuals, 52% of the uninjected fish also spawned due to the combined effect of stimulus created by the rush of water and the spawning activities of the injected fish in the vicinity of the uninjected ones. In the present mass induced breeding attempt, it is felt that pheromonal secretion might have increased the fish reproductive instinct. The mass induced breeding technique in earthen pond is simple and advantageous, as it does not require expensive components like plastic pools, aquaria and hapa. Further, the breeding environment helps the eggs to hatch out and youngones to grow under parental care for some time.

Acknowledgement

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References

1. BANERJI I, S.R.1974. Hypophysation and Life history of *Channa punctatus* (Bloch). *J.Inland. Fish.Soc.* India. 6:62-73.

2. DIANA, J.S, CHANG, W.Y.B. OTTEY, D.R. CHUAPOCHUAK. W. 1985. Production systems for commonly cultured freshwater fishes of south east Asia. In international progress report No.7 (ed. by Great lake and Marine water centre) pp.75-79.

3. NG. P.K.L. and LIM, K.K.P. 1990. Snakeheads (Pisces:Channidae): natural history and economic importance. In : essays in Zoology. Papers commemorating the 40th Anniversary of the Department of Zoology (ed.by.L.M. Chou and K.L.P. Ng) pp 127-152. National University of Singapore, Singapore.

4. MURUGESAN, V.K. and KUMARAIAH. (1984) A simple technique for mass breeding of murrels. *J. Inland Fish. Soc.*India **16**, pp 15-18.

5. JOSEMON, P.K., M.A.HANIFFA, T.A.SETHURAMALINGAM and S. ARULSELVAN, 1994 Chicken intestine as supplementary protein source for potential murrel culture. In proceedings of the National Symposium Aqua for 2000 A.D.pp263-267.

6. SAMPATH, K.1985. Food intake, Conversion and Surfacing activity as a function of density and water exchange in air breathing fish, *Channa striatus*, Aquaculture 46:201-213.

7. KHANNA, S.S.1978. An Introduction to Fishes, (Second Edition) Central Book Depot, Allahabad. pp,428.

8. HANIFFA, M.A. SHAIK MOHAMED, J and MERLIN ROSE, T.1996. Induction of ovulation in *Channa striatus* by SGnRHa. *Fish.chimes*.2,23-24.

9. PARAMESWARAN, S and V.K. MURUGESAN. 1976. Observations on the Hypophysation of Murrels (Ophiocephalidae). *Hydrobiologia.* Vol.50.1, 81-87.

10. LAGLER, K.F. 1982. Freshwater Fishery Biology, W.M.C. Brown company publishers, Iowa 2nd edn, pp 108.

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WSSV (PCR +*ve* and PCR -*ve*) Management in Shrimp Farming

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The authors are from a group of researchers involved in the epidemiological studies of White Spot Disease, a project funded by Department for International Development (DFID), United Kingdom. The group was involved in producing and analysing PCR results for WSSV detection in more than a thousand of various samples collected from the shrimp farming area. They present their views based on their research experiences and also based on the available literature.

PCR is a powerful technique for the detection of shrimp viral pathogens. Screening *Penaeus monodon* post-larvae (PL) by PCR for WSSV has become a routine practice in the shrimp farming industry. But there is need for careful assessment and interpretation of a 'PCR result' to adopt PCR screening of PL as a health management tool.

PCR screening of shrimp brood and seed for WSSV has become a routine practice in different shrimp farming countries of the world. The practical issues and implications of PCR results are not properly interpreted by many of those concerned in the industry. Issues like, what is PCR +ve or PCR -ve?, what can contribute to PCR positivity/negativity?, what are false positive and false negative results?, what is the relationship between PCR result and disease outbreak?, what is the importance of sampling in PCR screening, etc., are not clearly appreciated by shrimp farmers, shrimp hatcheries, diagnostic labs, consultants, administrators and policy makers. In this direction, it is strongly felt that there is a need for enlightenment and debate on the issues and implications of PCR results.

White spot disease and its impact on the industry

Ever since the first documented outbreak of white spot disease in Japan and China during 1993 (Nakano *et al.*1994, Chou et al. 1995), the disease has spread to most parts of the world and WSS epizootic have reached pandemic proportion. The causative agent, white spot syndrome virus (WSSV), is an enveloped, double stranded DNA virus and is extremely virulent causing total mortality in culture ponds within three to ten days from the onset of first clinical signs (Lightner 1996). Such massive and quick spread of mortality is often seen to lead to emergency harvest, as the only choice, as there is hardly any alternative health management strategy. Till date, there is no evidence of disease resistance/tolerance in any of the cultured shrimp. WSSV has thus become the focal concern in the shrimp industry.

Although light on several vital aspects of WSSV has been thrown by various researchers, till date no holistic health management approach has emerged to contain the spread of the disease. The disease management strategy with respect to WSSV is at present solely confined to early diagnosis and prevention of entry of the pathogen into the culture systems. Stocking of WSSV-free PL has been suggested to the shrimp farming industry as a major health management strategy and in this context 'PCR screening' of PL for WSSV has become a routine practice in the shrimp industry. There are reports of WSSV infection in the reproductive tissue of the parental spawners (Lo *et al.* 1997, Mohan *et al.* 1977) and it is now known that WSSV can spread vertically (either biologically or mechanically) from the broodstock to the offspring. It was also clearly shown that the progeny of PCR- positive broodstock are also infected and many times test positive by 2-step PCR and occasionally by 1-step PCR (Lo & Kou 1998). Looking into all these factors the rationale of screening of PL batches by PCR seems relevant. However, the relationship between the PCR status of the seed and the WSS outbreak in culture ponds is not always straightforward. In view of this, there is a need to critically analyse the utility and reliability of PCR results and its proper interpretation in the perspective of shrimp health management.

Why PCR screening?

PCR is a powerful diagnostic technique to detect pathogens. It has wide applications in human and veterinary medicine and in researches in the field of molecular biology. The PCR detection is based on amplification of a specific sequence of DNA present in the pathogen (Erlich *et al.* 1988, Oste 1988). Due to its high specificity and analytical sensitivity, PCR has its advantage over other conventional diagnostic techniques. For the detection of shrimp viral pathogens, PCR is at present the most routinely used diagnostic. In fact, for the detection of virus in the latent carriers and lightly infected specimens, PCR is the sole diagnostic tool and hence it is very effective in health certification programme. Several PCR methods both for 1-step and nested PCR have already been described for the detection of WSSV (Lo *et al.* 1996b, Maeda *et al.* 1998, Nunan *et al.* 1998). PCR screening of a PL batch assures the farmers in stocking WSSV free PL into the ponds and hence the 'PCR results' have

become a highly volatile issue in the Asian shrimp industry. The available evidences suggest that while PCR screening of *Penaeus monodon* PL for WSSV can significantly reduce the risk of crop failure, such risks could be further reduced by good pond management practices that minimize stress on the shrimp despite the presence of WSSV in the culture pond.

As a diagnostic technique, PCR is the most sensitive and specific tool, but the utility of this technique for the shrimp farming industry should not be overemphasised. Several practical aspects should be considered before adopting PCR as a health management tool. Many of such practical issues involved while taking decisions based on a PCR result are dealt with hereunder.

PCR screening of PL for WSSV: Practical Issues

PCR provides only a binomial result i.e., either Positive (+) or Negative (-) and it cannot provide any information on the state of infection or the infectivity of the pathogen. Farmers are always askance to take any decision based on this '+' or '-' result, as any wrong result would lead to a precarious option while making decisions. It is important to know that a PCR is more likely to provide a false positive and false negative result. Let us understand the various issues involved in false positive and false negative results.

Issues of false positive: A true positive result derives from actual infection whereas false positive can occur due to several reasons. Theoretically, PCR can detect the presence of a single DNA fragment and hence the scope of a false positive is high.

***Surface contamination and Passive contamination*:** These can provide a false positive result. A sensitive PCR can also detect presence of viral DNA in the water or on the sample surface, which is otherwise not a true infection. Passive contamination can occur in filter feeding organisms and intestinal tract of fish ingested with infected animals.

***The 2-step nested PCR is more prone to false positive results*:** The nested PCR involves the use of a new tube for the second step and lead to high risk of contamination due to transferring of template. Presence of already amplified product in the form of aerosol can lead to carry over contamination. Hence execution of a nested PCR procedure involves high operator proficiency and utmost care. Apart from all these, contamination through equipment, glassware, sample to sample cross contamination etc., can also occur if proper lab practice is not followed. To avoid such contamination there should be physical separation of pre-PCR and post-PCR areas and strict lab set up specification should be followed.

Thus, a positive result can occur due to the presence of intact virus (true positive), the presence of DNA fragments complementary to the primers or due to sample-sample cross contamination.

PCR-positive and True Infection: A productive viral infection is said to occur when there is entry of the infective viruses into the target tissues and consequent replication of the virion particles leading to fresh cycles of infection. This process leads to establishment of the pathogen in the host population thereby resulting in mortality or health abnormalities. Hence mere presence of the pathogen need not necessarily lead to the disease in an individual or a population.

***Presence of non-viable viral particles*:** PCR detects only a fragment of DNA in the virus and not necessarily intact, viable virus. Basically a virus comprises a nucleoprotein core and a protein coat (capsid); in some viruses with a lipoprotein envelope, the receptor binding sites present on the outer protein coat helps in attaching the virus to the host cell receptors and thus initiates the pathogenesis following entry of nucleocapsids into the cell, uncoating of nucleic acids and thereafter propagation of the new viruses in a complex biochemical pathway. Hence, mere presence of a piece of viral DNA does not provide an answer whether the virus is live, intact or infective. Further, in cellular latency phases there may be innumerable immature virion particles inside the host cell. These virion particles are again non-infectious. Thus a PCR positive result does not give a clear indication that the virus is replicating inside the host cell or there is presence of infectious material.

Example: The pelleted feed prepared from shrimp meal containing WSSV infected shrimps may consequently test positive by PCR due to the presence of viral DNA, but in reality due to the processing temperature and storage the virus would have lost its infectivity and intactness. Sometimes shrimps collected from the check tray (where PCR positive feed may be present) may again test positive by PCR due to surface contamination. There are increasing instances of shrimp feed testing positive by nested PCR (Maeda *et al.* 1998).

Issues of False Negative in PCR Detection: A true negative result refers to the absence of infection. False negative result can occur due to various factors. Most often in the shrimp farming industry, a PCR negative result is taken for granted as absence of infection and certifying the PL batch as WSSV-free; but in the routine screening practices, a false negative result is more likely. The various factors involved in false negative issues are rather more important from the practical point of view.

***The Sampling Issue*:** The sampling strategy and the sample size are the major factors for statistical validity of a PCR result while screening a PL batch; which is often not given any importance in the routine screening practices. PL batches coming from a hatchery usually number from 1 to 5 lakhs and may comprise progeny of several spawners. Testing 20-30 PL per batch may lead to high probability of sampling error and consequent false negative results. For instance, there may be very few numbers of infected PL in a population, which might go undetected when a small sample is taken to represent. According to statistical model for quantitative veterinary epidemiology (Canon & Roe, 1982), in order to detect a prevalence of 1% in a population of 10,000 or more with 95% confidence, a minimum of 297 animals should be tested.

Similarly a sample size of 50 and 150 gives 95% confidence in detecting up to 5% and 2% of prevalence respectively.

Therefore, based on the statistical principles of random sampling, a minimum of 300 PL should be collected and analysed per tank or pond. In routine screening practice, usually 20 to 30 PL are tested; in such a case, if a positive result is obtained, then it would indicate high prevalence whereas a negative result can many times be a false negative result especially when the prevalence in the population would be low. In a more recent study (Withyachumnarnakool 1999) carried out to identify the association of PCR positive PL and the grow out performance, about 50 PL were tested to represent the infection status of a PL batch and the possibility of false negative was discussed where it was emphasized to test at least 150 animals to reduce the chances of such false negative result.

The PCR Sensitivity Issues: Different PCR procedures offer different levels of sensitivity depending on the sample preservation and DNA extraction methods, size and nature of the target sequences and the method of detection of PCR products (Sambrook *et al.* 1995). A 2-step nested PCR would be more sensitive than the 1-step PCR alone. It was found that the sensitivity of the nested PCR was thousand fold more than the 1-step PCR and as low as 20 copies of the target DNA could be detected by the nested PCR (Lo *et al.* 1996, 1998, Maeda *et al.* 1998). Similarly, the sensitivity of 1-step PCR itself would vary depending on the size of amplicon. Usually a shorter amplicon size may provide a greater sensitivity than a larger amplicon size. Hence, a sample that tests positive by a 1-step PCR may test positive only after 2-step PCR by a less sensitive technique. Similarly a 2-step positive sample may test (false) negative by a less sensitive technique. The farmers should be aware of the fact that different PCR methods offer different levels of sensitivity. In India, there are several PCR diagnostic centers and there is no uniformity in the PCR methods followed; consequently there may be conflicting PCR results for the same sample when tested in separate laboratories.

Here it should be noted that whatever the sensitivity of a PCR method, the PCR negative result as like any other detection method provides an indication that the level of virus in the sample is below the detectable limit rather than a guarantee that the sample is virus free. Hence the possibility of a false negative cannot always be ruled out.

Selection of Tissue for PCR Analysis: For effective PCR screening strategy the tissue is also very important. For WSSV detection, the most preferred tissues are the gill, pleopod, haemolymph, muscle and cuticular epithelium in adult shrimp (Kou et al. 1998). Certain tissues may be infected only at a later stage and hence may not be suitable for PCR assay during early or latent infection. However, tissue selection may not be a major problem for PL screening since usually the whole PL is used for PCR detection.

Non-Specific Inhibitors: Although PCR can be performed in almost all the target tissues, there are chances of false negative result due to presence of PCR inhibitors in certain tissues. Knowledge of such inhibitors is very important for PCR analysis. For instance, the eye-stalk with the compound eye of the *Penaeus monodon* brooders when assayed gave consistently false negative result (Lo *et al.*, 1997) suggesting the presence of such PCR inhibitor(s) in the compound eye. Hence, presently for routine screening of broodstock the eye-stalk without the compound eye is used. The presence of PCR inhibitors has been reported in various complex biological substances.

Degradation of Nucleic Acids can also lead to false negative result. This can happen especially in cases where the tissue is not properly fixed or preserved which often lead to tissue degradation. When there is large amount of nucleases present in certain tissues, disintegration of the intact viral DNA may occur and there may be chances of failure in amplification.

Due to these potential sources of errors, PCR results should be confirmed by at least one other diagnostic procedure such as fluorescent antibody test, *in situ* hybridization and/or histology. In a nutshell, the more sensitive a technique is, the more likelihood of a false positive result.

PL Quality Assessment: What should be the Method of Choice?

Stocking post-larvae of the highest quality possible, healthy and free of pathogens is no doubt very much required. Success of a shrimp farm will depend on the quality of the post-larvae and the on-farm management practices. Hence a WSSV-negative seed is always good for the industry since an animal with the pathogen is always at risk of developing disease. But the argument here is about the acceptable level of risk for a particular farming system.

For each type of culture system, selection of an appropriate screening strategy requires careful assessment of the existing level of infrastructure, the available level of investment and the acceptable level of risk. The available literature on the relationship of WSSV PCR-positive PL and growout performances would provide some ideas in evaluating these aspects. There have been conflicting opinions on whether stocking of PCR positive seed leads to WSSV outbreak in the culture ponds. In one retrospective study (Withyachunarnakool 1999), it was found that stocking 1-step positive PL was a major risk factor for WSSV outbreak. Majority of the ponds stocked with PCR positive PL were failure, but still there were ponds which were successful despite stocked with 1-step positive PL. Similarly in the study of Lo *et al.* (1998), it was found that the PL batches with heavy infection (1-step positive) were leading to crop failure and the PL batches with low level of infection were able to survive from the larval stages till they were harvested. More recent reports suggest the long-term presence of WSSV in cultivated shrimp without any overt disease outbreak and the progeny of 2-step positive brooders were able to survive 13 months of culture period (Tsai *et al.* 1999).

Now, what is important for a poorly

resourced farming system is a successful crop upto four months of culture period with/without the presence of the pathogen in the system. It would be extermely difficult to eliminate completely the virus from a culture system since WSSV has become endemic to most culture areas and also in the natural shrimp population. Reports from Thailand and Japan suggest moderate to high (60 to 75%) prevalence of WSSV in the captured brooders (Lo *et al.* 1997, Maeda *et al.* 1998). Studies in India have also shown prevalence of WSSV in the captured brooders (Otta *et al.* 1999). Looking into such high prevalence of the virus it would be very difficult to obtain substantial quantities of PL batches from hatcheries, which are completely negative for WSSV. Rigorous screening of PL batches or the broodstock by 2-step PCR may provide better quality PL, but the use of highly sensitive (2-step nested) PCR screening methods often requires significant investment by hatcheries and at times may lead to false positive results. Further, this strategy will lead to rejection of PL batches with low level of infection or low prevalence that otherwise may have an extremely low risk of crop failure.

Hence, it would be a more meaningful strategy for the shrimp industry if less rigorous screening method of PL is considered. The ultimate aim should be exclusion of PL batches with high level of infection. This would require application of a less sensitive PCR, rather 1-step PCR or an alternative screening procedure of similar sensitivity whereas the use of nested PCR should be restricted to health certification and quarantine purpose. Evaluation of a simple and cheaper antibody-based dip-stick and immunodot diagnostics sensitive enough to cull out PL with high viral load would help the industry in this regard. Quantitative PCR may also provide a realistic estimate of the level of viral load; but it would be a sophisticated technique and may not be applicable for the routine screening. The ultimate aim of any health management strategy should be to live with the pathogen rather than to put effort in elimination of the very natural presence of the pathogen, which is otherwise an extremely difficult task.

References

CANON R.M. ROE R.T (1982). Livestock disease surveys: A field manual of veterinarians. Australian Government Publishing Service, Canberra.

CHOU H.Y, HUANG C.Y, WANG C.H, CHIANG H.C, Lo CF (1995). Pathogenicity of Baculovirus infection causing white-spot syndrome in cultured penaeid shrimp in Taiwan. *Dis Aquat Org* **23**:165-173

ERLICH H.H, GELFAND D.H, SAIKI R.K (1988). Specific DNA amplification. *Nature* **331**:461-462

LIGHTNER D.V (1996). A handbook of pathology and diagnostic procedures for disease of penaeid shrimp. *World Aquaculture Society*, Baton Rougue, LA.

LO C.F, CHANG Y.S, CHENG C.T, KOU G.H (1998). Monitoring cultured shrimp for white spot syndrome virus (WSSV) infection during their growth period by polymerase chain reaction. In: The 5th Asian Fisheries Forum, International Conference on Fisheries and Food Security Beyond the Year 2000, Chiengmai, Thailand, p127

LO C.F, HO C.H, PENG S.E, CHEN C.H, HSU H.C, CHIU Y.L, CHANG C.F, LIU K.F, SU M.S, WANG C.H, KOU G.H (1996b). White spot syndrome baculovirus (WSBV) detected in cultured and captured shrimp, crabs and other arthropods. *Dis Aquat Org* **27**: 215-225

LO C.F, HO C.H, CHEN C.H, LIU K.F, CHIU Y.L, YEH P.Y, PENG S.E, HSU H.C, LIU H.C, CHANG C.F, SU M.S, WANG C.H, KOU G.H (1997). Detection and tissue tropism of White Spot Syndrome Baculovirus (WSBV) in captured broodders of *Penaeus monodon* with a special emphasis on reproductive organs. *Dis Aquat Org* **30**: 53-72

LO C.F, KOU G.H (1998). Virus-associated White Spot Syndrome of shrimp in Taiwan: A review. *Fish Pathol* **33**:365-371

MAEDA. M, KASORNCHANDRA. J,ITAMI. T, SUZUKI. N, HENNING. O, IMMAMURA. T, KONDO.M, HIRONO. I, AOKI. T, TAKAHASHI. Y (1998). Detection of penaeid rod-shaped DNA virus (PRDV) in wild caught shrimp and other crustaceans. *Fish Pathol* **33**: 373-380

MOHAV C.V, SUDHA P.M, SHANKAR K.M, HEGDE. A (1997). Vertical transmission of white spot baculovirus in shrimps-a possibility? *Current Science* **73**:109-110

NUNAN L.M, POULOS B.F, LIGHTNER D.V (1998). The detection of white spot syndrome virus (WSSV) and yellow head virus (YHV) in imported commodity shrimp. *Aquaculture* **160**:19-30

OSTE. C (1998). Polymerase chain reaction. *Boitechniques* **6**: 162-167

OTTA S.K, SHUBHA. G, JOSEPH. B, CHAKRABORTY. A, KARUNASAGAR. I, KARUNASAGAR. I (1999). Polymerase chain reaction (PCR) detection of white spot syndrome virus (WSSV) in cultured and wild crustaceans in India. *Dis Aquat org* **38**: 67-70

SAMBROOK. J, FRITCH E.F, MANIATIS. T (1989). Molecular cloning: A laboratory manual, 2nd edition, Cold Spring Harbor laboratory, Cold Spring Harbor, New York

TSAI M.F, KOU G.H, LIU H.C, LIU K.F, CHUANG C.F, PENG S.E, HSU H.C, WANG C.H, LO C.F (1999). Long-term presence of white spot syndrome virus (WSSV) in a cultivated shrimp population without disease outbreaks. *Dis Aquat Org* **38**: 107-114

WITHYACHUMNARNKUL. B (1999). Results from black tiger shrimp *Penaeus monodon* culture ponds stocked with postlarvae PCR-positive or -negative for white-spot syndrome virus (WSSV). *Dis Aquat Org* **39**: 21-27

Sanitech

In our November 2001 issue (Vol.21 No.8, Page 15) news item was published under the caption 'Sanitech', a disinfectant manufactured by VAP Ltd.

We have now been informed that VAP Ltd., (Vetcare Alltech Private Limited) formed in association with Alltech, USA, was manufacturing Sanitech. It is now learnt that this association has ceased from January 2001. Thus, Sanitech is no longer manufactured by VAP Ltd.

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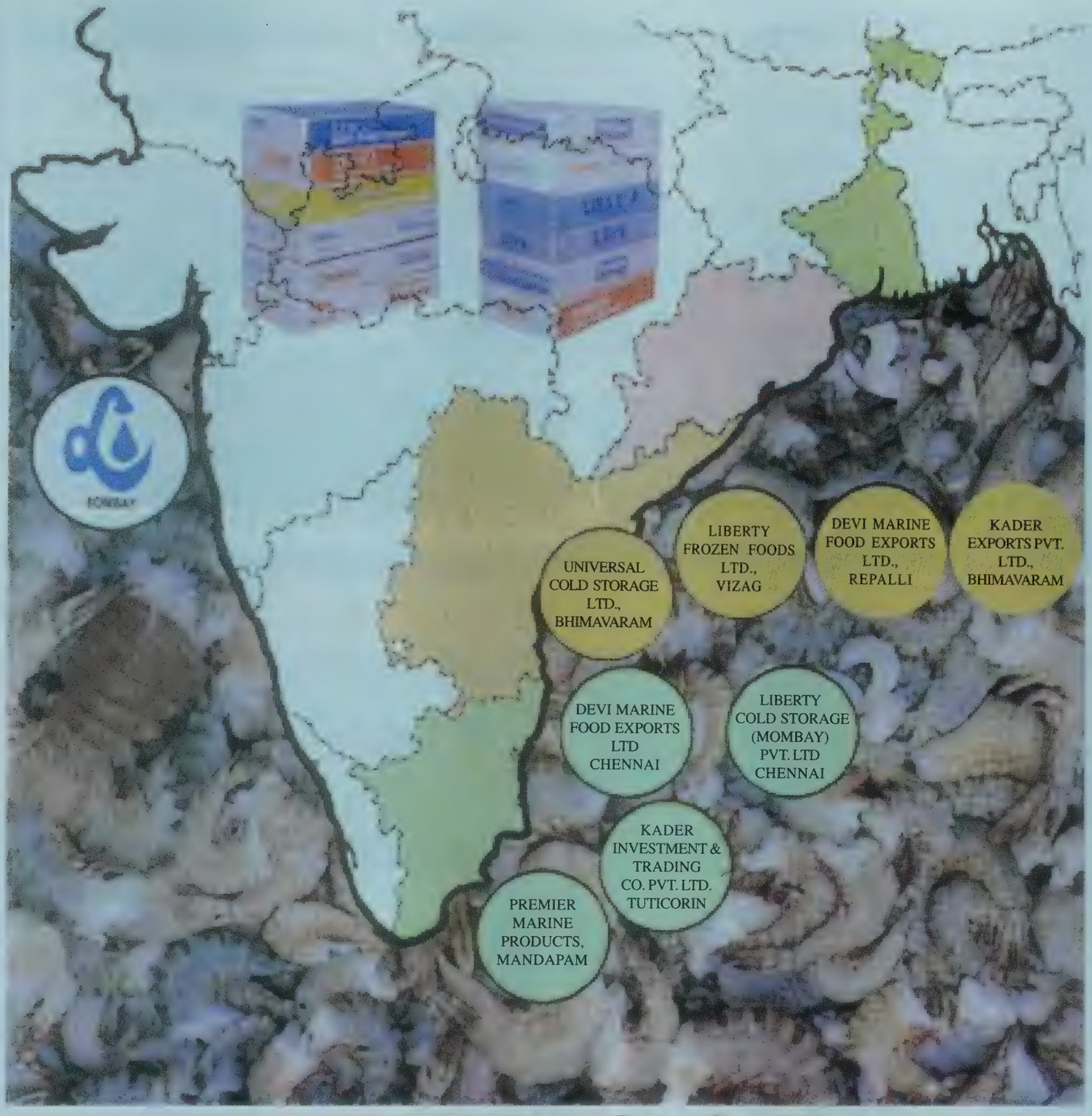
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Disease Problems In Shrimp Aquaculture: Their Prevention And Control

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Fish production by capture has been stagnant world over during around past ten years. In this context, as a means to improve fish production, the role of aquaculture has gained in importance. So much so, during the last decade, aquaculture has been the fastest growing industry in the food sector, recording a growth of over 16% annually, dominated by shrimp culture. A depressing aspect, however, was that towards mid 90s of last century, shrimp aquaculture suffered a setback due to viral diseases. The result was that a drastic reduction in culture shrimp production was recorded in China, Indonesia, Philippines and India. In Asian countries, annual losses of culture shrimp, due to disease problems in the last decade have been estimated to be more than US $ 3,000 million.

While most of the disease problems are attributed to bacteria, viruses, fungi or parasites, the most serious of them are caused by bacteria and virus. For management of disease problems, early detection of causative pathogens is very important. Recently molecular techniques have been found to be helpful for detection of pathogens at subclinical stage itself and also to identify carriers of infection. Disease management strategies should be based on the premise that interaction of host, pathogen and environment play a crucial role in determining the health status of shrimps. Strategies suggested include avoidance of pathogen and its carriers, improvement of host conditions through immunostimulation and management of pond conditions.

Strategies to avoid pathogens

An ideal strategy for prevention of disease would be to avoid pathogens in shrimp culture environment. This strategy, however, rarely succeeds. Most often disease problems are caused by pathogens which are naturally present in sea water. For eg., the luminous bacterium causing problems in hatcheries and growout ponds are commonly present in sea water and in association with broodstock. Even pathogenic viruses such as WSSV and MBV may be present in apparently healthy broodstock. Recent studies have shown that WSSV has a very wide host range and may be present in a number of crustacean species including shrimps, crabs, zooplankton and even aquatic insects. Therefore, for avoiding pathogens, some of the measures which can be taken are :

a) Rapid detection of pathogens in broodstock, larvae and carrier animals even before they show signs of disease.

b) Avoidance of broodstock and larvae carrying latent or dormant pathogens.

c) Identifying and excluding carriers of pathogens from the culture environment.

d) Avoidance of water contaminated with pathogens.

e) Elimination of pathogens from the culture environment using probiotics and biocontrol agents.

Diagnosis of disease

For effective management of disease problems, rapid diagnosis at an early stage is very essential. Whitespot viral disease, which has now become rampant, is a major problem causing concern to the aquaculture industry. There is no known treatment for viral diseases even in mammalian systems. The best solution to the problem of viral disease in shrimp aquaculture is to develop domesticated broodstocks, the reason being that the whitespot virus has already affected the wild broodstock and a number of crustaceans. Most often, the broodstock and other marine crustaceans do not show any signs of disease, but they carry the virus which remains dormant or latent in these animals.

It is important to identify brooders carrying the virus and to avoid their usage in hatcheries. It is also necessary to make sure that post-larvae used as seeds by shrimp farmers do not carry this virus. To achieve these, the Department of Fishery Microbiology of the College of Fisheries has developed a very rapid and sensitive DNA based diagnostic test called "Polymerase Chain Reaction (PCR)". Using this test, it is possible to detect even dormant viruses in apparently healthy animals. To draw samples for this test, it is not necessary to kill the broodstock. A sample of walking leg or swimming leg of the broodstock is enough to test for the presence of the virus. PCR test can also be used to screen batches of post-larvae for the presence of latent viruses. It is now becoming common for farmers or hatcheries to draw samples of postlarvae from the tanks and send them to the College of Fisheries, Mangalore, for testing for white spot virus. The PCR test developed by the Microbiology Department is called "nested PCR" and this test is much more (above 1000 times) more sensitive compared to normal PCR. With this test, it is possible not only to detect latent viruses, but also to grade the degree of infection in the animals. The "Nested PCR" is done in two stages. If the test animals have high load of virus, the test comes out positive at first stage itself. On the other hand, if the viral load is very low, the first stage test is negative, but the second stage test is positive. Due to the extensive presence of the white spot virus in marine crustaceans, only a small percentage of larval samples are generally negative by nested PCR. When postlarvae are nega-

tive by first stage reaction but positive by second stage, they could be used for stocking ponds. However, pond conditions should be managed well to prevent stress to the animals, so that the virus does not gain upper hand. On the other hand, when postlarvae are positive by one step PCR, the risk of disease outbreak is higher.

Use of probiotics to eliminate pathogens

Probiotics have been in use in veterinary practice for a long time and the benefits that accrue include improved food absorption, reduced pathogenic problems and growth promotion. Probiotic microorganisms may eliminate pathogens by competitive exclusion or by production of antibiotic-like substances or through induction of non-specific defence mechanisms.

Methods to boost the natural defence system of shrimp

Though PCR test is helpful for testing the seeds for the presence of virus, it is not an end by itself. Disease outbreaks may occur even in ponds stocked with PCR negative seeds. Whitespot virus may enter culture system through various carrier animals (crabs, copepods or other wild shrimp), water etc. To improve the disease resistance of shrimp, the Department of Microbiology, College of Fisheries, Mangalore has developed an immunostimulant which contains yeast and bacterial cell wall components. Laboratory studies have shown that treatment of shrimp with immunostimulants can enhance their resistance against both bacterial and viral pathogens. However, in shrimp, the immune system is rather poorly developed and therefore, treatment with immunostimulants should be made every fourth day. What the immunostimulants do is to boost the natural defence systems of shrimp against diseases. Thus the immunostimulants do not have any harmful or residual effects on the shrimp.

Strategies to improve water quality and reduce stress

One of the most important causes of stress to the animals in a culture pond is the deterioration of water quality. This happens due to improper degradation of wastes in the pond. Scientific studies have shown that only 20% of the nitrogen introduced into the pond through feed is actually absorbed by the shrimp and 80% ends up in the pond environment. Shrimp excreta, exoskeleton shed during moulting and others contribute to the organic wastes accumulating in the pond. These are utilised by microorganisms present in the pond to produce toxic end products such as ammonia and hydrogen sulphide. Such toxic substances cause stress to the animals and make them susceptible to pathogens lurking in the environment or present in a dormant state in the host itself. To prevent environmental stress to the animals, it would be important to degrade the toxic waste products. Microorganisms are highly versatile and can utilise toxic substances such as ammonia and hydrogen sulphide and convert them to less harmful nitrate and sulphate. The concept of cleaning the environment using microorganisms has been around for sometime and the term "bioremediation" is used to describe the process of converting the environmental parameters to favourable levels using microorganisms. The Department of Microbiology, College of Fisheries, Mangalore has been working on the application of this concept of bioremediation to aquaculture systems. The Department has a collection of microbial cultures which can quickly convert ammonia to nitrate, hydrogen sulphide to sulphate and improve the water quality and sediment quality in aquaculture systems. Laboratory studies have clearly shown that these microbial consortia can correct water quality in shrimp ponds.

Development of probiotics

The term probiotic has been used to describe microorganisms which have a favourable effect on the host. In veterinary practice, lactic acid bacteria have been used for a long time to prevent colonisation of animal systems by pathogens such as *Salmonella*. Presently, the Department of Microbiology, College of Fisheries, has been working towards development of probiotics useful in aquatic animals. Studies conducted so far show that some marine bacteria have antagonistic activity against *Vibrio* spp which are pathogenic to shrimp. Such marine bacteria have potential for application as probiotics in shrimp culture ponds. Trials of these probiotics are being conducted in ponds to study the extent of benefit which probiotics can confer to shrimp survival and growth.

Research to help major carp culture

Culture of Indian major carps is contributing significantly to fish production in India. In Andhra Pradesh alone, nearly one lakh hectares have been brought under major carp culture. One of the major pathogens that infect major carps is a bacterium called *Aeromonas hydrophila*. This organism can cause a number of disease conditions such as haemorrhagic septicaemia, dropsy, ulcerative conditions etc. These organisms may also cause secondary infections following injury inflicted by parasites. The Department of Fishery Microbiology, College of Fisheries has been working towards developing a vaccine to kill this organism. Unlike shrimp in which a specific immune system has not yet been demonstrated, fish can mount a specific immune response against particular pathogens and therefore, one can think of developing vaccines for fish. The problem with *Aeromonas hydrophila* is that it is a heterogenous group made of several serotypes within a single species. The vaccine developed at the above mentioned Department is a polyvalent vaccine which can protect against a number of different serotypes. Further research on this organism is focused on identifying a protective antigen in this organism which can be used as vaccine.

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A publication of Fishing Chimes
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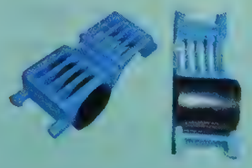


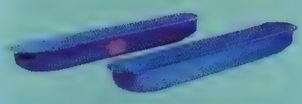
Bearing Cover& Rubber Bushing

Bearing Stand

Plastic Shaft

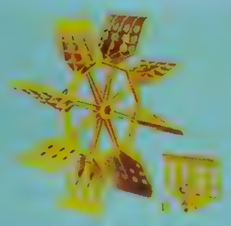
Plastic Frame

Screw Package & Plastic Nut

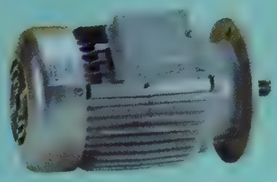


PE Float

PE Cover



Plastic Impeller

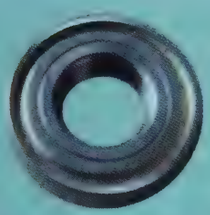


Motor

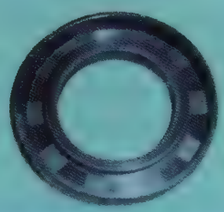
Reducer(14:1)

Motor fan

Reducer Bearing #6306

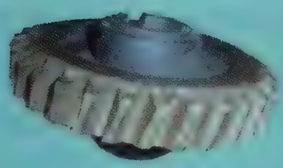


Reducer Bearing #6206



Oil Seal

Output Shaft



Worm Gear Wheel (14:1)

Reducer Bearing #30305

Input Shaft ((new 185mm)

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Introducing ..... Prof(Dr) R.Madhavi

Vice-Chancellor

Sri Padmavathi Mahila Viswa Vidyalayam, Tirupati, A.P.

Prof (Dr) R.Madhavi, the first woman Professor of Andhra University (Department of Zoology), has taken over recently as Vice-Chancellor of Sri Padmavathi Mahila Viswa Vidyalayam, Tirupati.

She has to her credit glorious academic and administrative achievements spanning over thirty years. A student of Prof. K.Hanumantha Rao (who was a student of your editor, although for a brief period) at Andhra University, she took her doctorate in 1968, after a brilliant passage in the same University, through B.Sc (Hons) and M.Sc. She joined the Department of Zoology of Andhra University in 1971 as a lecturer and rose in rank to Professorship in that Department by 1990. On the administrative front, she gained enormous experience as Chief Warden, AU Ladies Hostel; as Head of Department of Zoology, AU; as co-ordinator, UGC special Assistance Programme, Zoology; and as Chairman, Board of Studies in Zoology at the University. She has 30 years of teaching experience and has the distinction of publishing 108 papers *(Fishing Chimes* had the privilege of publishing a couple of papers authored by her). She handled seven research projects, related to fish diseases.

The professor was the recipient of three prestigions awards:1) Hareram Hazra gold Medal of Zoological Society of India, 2) B.P.Pandey memorial oration award of Indian Society of Parasitology and 3) Best teacher award of A.P.State Government.

She had the distinction of receiving two fellowship awards, one by Department of Zoology, University of Liverpool, UK(1980-81) and another by the Department of Pure and Applied Biology, Imperial College, London. She participated in over 20 national and international symposia, workshops etc., between 1981 and 2000. She holds membership of several professional bodies in India and abroad.

Prof. Madhavi is a valued subscriber to *Fishing Chimes* for the past several years. A specialist in parasitology, helminthology and pathology, in recent years she concentrated her attention towards disease incidence in cultured crustaceans and fish. There is a saying that, to get into fisheries sector is difficult, and ones one gets in it is difficult to get on, but having learnt to get on, it becomes difficult to get out of it. The professor passed through the first two stages and is now is face to face with the third stage. *Fishing Chimes* and the entire fraternity of fisheries scientists in and outside the country, particularly the women fisheries scientists, would not like her to get out of the orbit of fisheries and *Fishing Chimes* is hopeful that she would introduce a degree course in fisheries at the Vidyalayam so as to create a band of women candidates to set up fisheries enterprises of their own or to secure employment in on-going enterprises. Surveys indicate that women function surprisingly well as hatchery managers, farm managers and efficient technicians at PCR labs etc.

Fishing Chimes also entertains the prediction that the Vice-Chancellor would continue her patronage towards *Fishing Chimes*.

..... About Dr.Kaza Janaki Ram

Director, Central Institute of Freshwater Aquaculture

Dr. Kaza Janaki Ram, who took over recently as Director of the prestigious Central Institute of Freshwater Aquaculture, Bhubaneswar, is an outstanding Freshwater Culture Fishery Scientist of India. The coveted Rafi Ahmed Kidwai Memorial Prize was conferred on him by ICAR, in recognition of his scientific achievements in aquaculture sector. Janki Ram came into limelight and earned a place among global fishery scientists with the breakthrough he achieved in the production of freshwater culture pearls. In recognition of this commercially significant achievement and other contributions he was awarded a 'Plaque De Honneur' for excellence in fisheries research in the field of freshwater pearl culture by the National Academy of Agricultural Sciences of India. Janaki Ram is a Fellow of the Indian Association of Aquaculturists and also of ISEP Science Academy.

He took Master's Degree in Zoology with specialisation in Marine Biology in 1968 and the Degree of Doctorate of Phi

losophy in Zoology for the work done on a limnological subject in 1972, from Andhra University. The scientist joined Central Inland Fisheries Research Institute (CIFRI) in 1972 and later moved over to Central Institute of Freshwater Aquaculture (CIFA) in 1987. He played a major role at the institute in the development of technologies of Composite Fish Culture, Freshwater Prawn Culture, Catfish Culture and Freshwater Culture Pearl Production. He undertook advanced studies in fisheries in the United Kingdom in 1989 under FAO/UNDP programme and made a fisheries study tour in Vietnam in 1995 under NACA programme. He has to his credit around 40 research publications in various reputed national and international journals including Nature. The scientist is also a member of Board of Examiners for graduate, post-graduate and doctoral degree students of Utkal, Berhampur, Andhra and Nagarjuna Universities, and Orissa University of Agriculture and Technology. He also heads the "Team of Excellence" on Freshwater Pearl Culture Project (NATP) at CIFA.

The freshwater fish farmers of the country and the entrepreneurship in freshwater culture sector have high hopes that, under the leadership of Dr. Janaki Ram, fortified by his vast research experience, the culture fishery sector would climb to reach new heights of endeavour in the development of new technologies, in a way to catch up with emerging and commercially viable technologies such as those relating to pondlining, closed recirculation systems polyculture systems with new combinations of species that have export potential, and also to extend research activities of CIFA to take culture of freshwater prawn and tiger shrimp to the culture waters to the heartland of the country. Nile/GIFT Tilapia having emerged as an important culture species with export potential, widely popular in various countries, the fish farming sector would look forward for initiatives to introduce eco-friendly technologies for the culture of this species, which has vast potential for augmenting incomes of farmers and also for augmenting export earnings of the country. *Fishing Chimes* joins the farming community in wishing Dr. Janaki Ram all the best in his new and elevated assignment.

Rainbow Trout Health Studies in H.P. Farms under Norway-aided Project

The successful implementation of Norwegian-assisted "Trout Farming Project" in Kullu Valley of Himachal Pradesh has opened up fresh opportunities for exploitation of streams and other flowing waters of Himachal Pradesh not only for fish production but also for employment generation in the upland areas of the State. Trout, which was rare to come across in H.P. ten years back, is presently available in plenty in departmental and private fish farms of the State. Several tonnes of trout produced in departmental fish farms in H.P. are now being sold in Delhi. Recognising the achievement, the Government of India sanctioned a 100% Centrally Sponsored Pilot Project viz., "Coldwater aquaculture" for implementation in different hill States viz., Jammu and Kashmir, Sikkim, Uttranchal and Himachal Pradesh with financial assistance of one crore of rupees to each of the States. The project envisages remodelling of existing Trout farms of the State, providing liberal subsidy upto Rs. 35,000/- per unit to 125 beneficiaries during the current year, setting up a trout feed mill, preparation of survey reports, and for stream improvement etc.

This apart, in recognition of the success of the bilateral project on Trout Farming, the Norwegian Government under their Institutional Co-operation Programme, has sanctioned another project "Fish health and nutritional studies" to be taken up jointly by the National Veterinary Institute, Oslo and the Department of Fisheries, Himachal Pradesh.

The project focuses on the upgradation of research and training facilities for effectively countering problems related to fish diseases in trout under farming so as arrest mortalities of trout occurring due to diseases. The project aims at establishment of first-ever National Labaratory on Fish Pathology of Coldwater Fishes, in Himachal Pradesh to cater to the needs of all the hill States of the country. Besides conducting studies on identification, enumeration and cataloguing of various diseases emerging in a trout hatchery, the laboratory would also help in raising a team of extension officers who would help trout fish farmers in controlling diesase infestation problems.

Under the 'Scientists exchange programme', the State personnel would visit leading Norwegian Institutes while Norwegian scientists would visit and work at the State fish farms. The exchange programme would obviously help the personnel of the State to acquire requisite expertise in the field of fish health diseases and enable them to eventually help the State in becoming not only a pioneer in trout-farming, but also emerge as the leading producer of trout in the country.

Record Fish Production from Gobind Sagar

The cumulative fish production from Gobind Sagar reservoir is likely to reach a record level of over 1200 mt valued at over Rs.250 lakhs in 2001-2002. Till mid-January 2002, over 900 t of fish valued Rs. 184 lakhs have already been harvested from this water body surpassing the earlier annual record of 837 tonnes valued Rs. 177 lakhs. The maximum landing was recorded from Bhakra centre (63.1%) followed by Zagatkhana (13.8%), Lathiyani (7.8%), Mandli (5.8%), Bilaspur (5.4%) and Nakrana (4.1%). Silver carp accounted for 82% of the composition followed by mirror carp (7.5%), Indian Major Carps and mahseer (7.2%) and miscellaneous ones (3.0%). In fact, at national level the fish production of Gobind Sagar reservoir has created a record among the country's 98 medium & large reservoirs by maintaining the highest per hectare fish production for over two decades or so.

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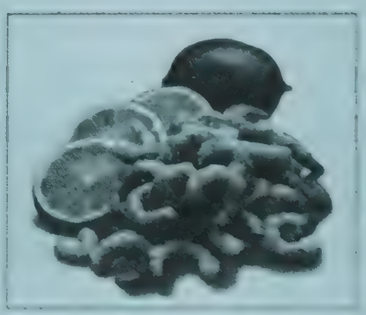

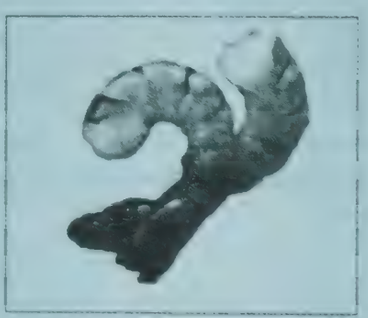

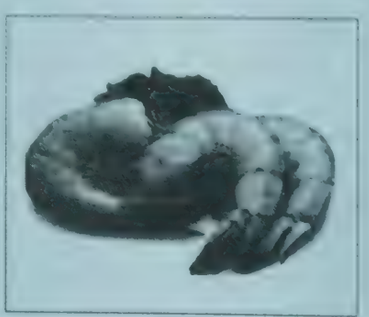

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Kerala's Aquaculture Development : Vietnam (Mekong delta) Model's Relevance

B.Madhusoodana Kurup
Professor & Principal Investigator of Nuffic South-South Project
School of Industrial Fisheries, CUSAT, Cochin –682 016

Vietnam is emerging as one among the five topmost nations, on a global basis, in respect of fish production through aquaculture, Vietnam, like India, is largely agriculture oriented, with over 50% of the people, living in rural areas, continue to depend on agriculture for their living. The Mekong river delta, (Fig. 1) the rice bowl of Vietnam, includes 12 provinces in the southern part of the country. This region has a total area of 4 million ha. Endowed with a tropical climate with an average temperature of 27° c, this region receives an average rainfall of 1800mm. This region is characterised by low land, fertile soils and a dense net work of rivers. Of the total agricultural lands, of the area, the extent of water bodies is estimated at about 954,350 ha comprising 641,323 ha of freshwater and 313,027 ha of brackishwater bodies. This region contributes about 50% of total rice production of the country, of which 80% of rice production is exported. Aquaculture in the Mekong delta, mainly located inland, has been remarkably developed on sustainable lines in the recent years(Edwards, 1994).

In 1990, fish production in the Mekong delta was 259,000 tonnes from capture fishing and 205,000 tonnes from aquaculture. It is estimated that about 53 per cent of the total water bodies are suitable for aquaculture of which only 52 per cent of them have been brought under farming. In 1988, farmers utilised about 98,598 ha for fish culture and 204,000 ha under shrimp culture respectively while 24,000 ha were allocated for the culture of the giant freshwater prawn *Macrobrachium rosenbergii*. Production from fish, shrimp and giant freshwater prawn was in the order of 303,000 tonnes, 80,000 tonnes and 8,000 tonnes respectively. Aquaculture in this region contributes to 50 per cent of total aquatic production. On a national basis 60 per cent of cultured aqua produce is exported. Most of the fish, shrimp and giant freshwater prawn producing activities are conducted by small scale farmers. Culturing fish and giant freshwater prawn has several advantages to farm households, not only in terms of reducing malnutrition, increasing household income and creating jobs, but also some advantages in terms of environmental management (Singh, 1995). Available reports suggest that the growth rate of aquaculture in the delta is over 10 per cent, while that of the whole country is about 6 per cent.

Fish Farming in Mekong Delta

Freshwater farming practice is being carried out in Mekong delta since the early 1960s, but widespread commercial development has become vibrant only in the past decade. A wide variety of fishes and crustaceans are used for culture comprising both indigenous and exotic species. The candidate shrimp species used for the brackishwater farming are mainly *Penaeus monodon*, *P. indicus* and *P. mergueinsis*. On the other hand, the giant freshwater prawn *Macrobrachium rosenbergii* is the most favoured one in the freshwater aquaculture scenario.

While the present production of this species through aquaculture is very low, there is an aimed initiative from the Vietnamese Government to promote the culture of this species in a massive way, because of its export value and potential to raise income levels of farmers in the Mekong delta. The available reports suggest that the wild stocks of this resource is getting alarmingly depleted over the past decade due to various human interventions. In this context, concerted attempts are being made to replenish the stock through farming. In Vietnam, the distribution of this species is recorded from central Vietnam(Nha Trang City) to the south, and is found mostly in certain provinces of the Mekong delta including Can Tho, Vinh Long Tra Vinh and Soc Trang. In Mekong delta, there are two observed peaks of high prawn yield, one from April to June and the other from August to October. Till a few years back, *M.rosenbergii* culture in Mekong delta was mainly dependent on prawn juveniles collected from wild resources.

The finfishes cultured in Mekong delta comprise exotic carps such as Chinese carps, Indian major carps and Nile Tilapia, while the indigenous fishes such as Siver carp, Asian catfish, Pangasius catfish and gouramy are also included in the culture basket of Mekong delta. In the freshwater sector, the delta is dominated by many aquaculture systems such as rice-prawn/fish integrated system, fish-livestock system, fish/prawn –plant crop system, fish cage culture and prawn pen culture. In addition to the main indigenous species such as Silver barb fish, Asian catfish, Snakehead fish, Snake-skin gourami, Giant gourami, Pangasius catfish and freshwater prawn; other prime exotic species such as Indian carps, Chinese carps and Tilapia were also introduced to the region for culture under different systems. Production may range from 0.3 to 11 tonnes/ha depending on the system followed. Especially, fish cage culture produces a very high yield up to 100-150 kg/m^3 or 1,000-1,200 t/cage.

Diversified types of farming systems could be seen in Mekong delta. Among them expansion of freshwater culture is certainly conspicuous. The activities are

now plumping towards polyculture with fish and prawn/tilapia and rice-prawn and vegetable-prawn integrated culture. Integration of prawn with paddy is emerging as the most popular culture system in Mekong delta. Monoculture of prawn in ponds is also getting popular in selected pockets. The other types of cultures being practiced in this region are paddy-fish - prawn, garden–fish–livestock, livestock-fish, shrimp-mangrove-forestry, paddy-shrimp etc. Intensive monoculture of shrimp is in an expansion phase in different regions of Mekong delta. It may be mentioned here that intensive cage aquaculture of fishes is an age old tradition in this part of the country (Mekong delta).

Status of Prawn/Shrimp Hatcheries and Seed Availability

Much of the commercial culture of *M.rosenbergii* is dependent on juveniles of this prawn collected from the wild. At present, the wild source does not fullfil to the requirements of farming both qualitatively and quantitatively. Consequently, demand for hatchery produced seed as per the requirements of the farmers has been on the rise in recent years. The techniques of standardisation of hatchery production of Scampi (giant freshwater prawn) seeds is gaining importance and many institutions in Vietnam are deeply involved in the production of post-larvae of this species in hatcheries. As a result of transfer of technolgy of seed production of scampi to the stake holders,notably by the aquaculture and Fisheries Research institute of the Cantho University, more than 100 Scampi backyard hatcheries have been set up and are currently functioning in Mekong delta. As a result, the farmers' demand for scampi seed from the various regions is substaintially met, out of the production by these small hatchety units.

As regards fish seed production and supply is concerned, during the year 2000, 1800 million seed of silver barbs were produced and supplied. Around 2000 million nos of Pangasius cat fish seed was also produced. The production of seed in respect of Silver carp and Indian major carps, in contrest, were 400 and 500 million nos respectively. The production of Chinese carps (other than Silver carp) was far less at 200 million no's.

Institutional Back-up : The Aquaculture and Fisheries Science Institute of the Cantho University is primarily instrumental in developing appropriate technology suitable for Mekong delta aquaculture development and also its transfer to the farmers of Mekong delta.The institute and its five field stations maintain a good rapport with the fish farmers of the delta and provides necessary technical back-up for various types of aquaculture activities being carried out. Aquaculture and Fisheries Science Institute has been conducting B.Sc. (Aqua-culture) course since 1976 and the candidates who come out successfully from this institution are now serving the aquaculture industry in various provinces in positions such as farm and hatchery owners. They are also working as staff members in the University, and public and private organizations. The routine activities of the institute are as follows:

Standardisation of Prawn Seed Production Technology and its Transfer to the Farmers

Seed production of giant freshwater prawn has been first studied in Vietnam in 1984 at Cantho University with open-clear water system and closed-clear water system. Since then, several institutions in the country have been engaged in doing research in order to evolve a stable system of scampi seed production. However, until 1998, only a few scampi hatcheries had been established and they functioned in the whole Mekong Delta under open-clear water system. Since 1998, Aquaculture and Fisheries Science Institute, Cantho University has been following a new system of scampi seed production known as "Modified static green water system". The system is initiated by Ang (1986). After a 2-year period of experimentation for further development at the Institute, the system has been popularised throughout the country. As a result, more than 50 scampi hatcheries have been established and they are functioning successfully. More than hundred farmers were also trained by this institute in this system of seed production technology in Mekong delta which eventually was helpful in the setting up of about one hundred hatcheries at backyard level in this part of the country. Conducting of training programme on seed production of giant freshwater prawn is one among the important activities being carried out at this Institute. In addition, the Institute is also having a commercial hatchery with a production capacity of more than 15 million seed per annum and this caters to the scampi seed requirements of the farmers, at least in part. The static clear water system of giant prawn larviculture developed in Cantho University is basically the modified version of the technique developed in University Putra, Malaysia, under the supervision of Prof.Ang Kok Jee. This system has many advantages as compared to the clear water system of larviculture, which is being widely followed in India. Since there is no water exchange, the sea water requirement is minimal in this system developed by Cantho University. Therefore this system can be practiced in the interior places as well. Being less labour intensive it would render seed production more economic. The modified static green water system is ecofriendly as it stimulates a natural ecosystem in the rearing tank itself with the various ecological successions in the tank providing an environment conducive for the survival of larvae. The most salient feature of this system is that it allows the flora of bacteria to develop along with the algae in the rearing medium so that the chemical and biological factors of the rearing medium are always under control. The metabolites like ammonia and other toxic nitrogenous wastes formed in the rearing medium are detoxified to nitrates due to bioconversion, which can be well utilised by the algae present in the system. The dominant beneficial bacterial flora present in this system reduces the proliferation of the pathogenic bacterial

population in the rearing medium, which in turn reduces the chances of disease incidence. The beneficial feature eliminates the necessity of antibiotic applications in the larval rearing tanks.In India, the normal practice being followed is to apply antibiotics in larval rearing tanks but this is often done in excessive quantities. The usage of probiotics, which is also very popular in India, is not at all advocated in the Vietnamese system. The system of conversion of Ammonia and other toxic nitrogenous wastes into nitrates has many advantages such as simplicity in operation, need for less of laborious work, minimum sea water requirement, high survival rate, eco-friendly nature, production of healthy larvae which is due to non-application of antibiotics and probiotics, high economic returns, and above all, it is conducive for being adopted even at far off places from the sea.

Functioning of Backyard Scampi Hatcheries: As already mentioned, with the technical know how imparted by the Aquaculture and Fisheries Science Institute, Cantho University, about 100 backyard hatcheries are now functioning in Mekong delta. The recent momentum observed in the farming of *M.rosenbergii* in this delta is mainly due to the steady supply of seed from these hatcheries. The capacity of these hatcheries varies from 1 to 12 million seed per annum and coupled with this, in some of these hatcheries, seed production of catfishes, carps and gourami is also being carried out simultaneously. The hatcheries are constructed using metal or concrete pillars with supporting steal frames for the roof, and roofed with tin and transparent fiberglass sheet. The sides of the hatcheries are made up of wood and blue coloured plastic-slipaulin sheet. Good ventilation is also provided. Ring blowers and Chinese-made air pumps are used as air sources. Blue coloured plastic tanks of 500-litre capacity are used in all the hatcheries for larval rearing. In the large-scale hatcheries, cement tanks are used for brood stock maintenance. Hatchery owners prefer brood stock collected from the farm than from the wild. The sea water requirement is met by bringing brine with a salinity of 150 ppt from the adjoining province. They stock larvae @ 60-90 larvae/litre. Artemia and custard feed are used as feed. The final survival rate obtained in each larval cycle ranges form 30 to 70 %. Women members of the owner's family look after the hatchery activities in full and practically no separate labour force is employed for hatchery management.

Integrated Farming Systems (Paddy–fish, Paddy-prawn-crop, fish–crop, fish-livestock system)

Integration of *Macrobrachium rosenbergii* with rice alone and with crops: This is the most soughtout method in Mekong delta and an emerging farming practice,especially in Chauthanh and Omon districts in Cantho province which are endowed with extensive area suitable for integrated aquaculture. In this method, the hatchery produced or wild caught post larvae or juveniles are stocked @ 2-3/m^2 in the trenches of 1.5.-2 m depth, prepared in the periphery of the same paddy field during the first paddy crop in the early part of the year. In Mekong delta, there are three paddy crops, the summer autumn paddy is raised during March to June while the Flood, Autumn, Winter Paddy is cultivated during July to November. Winter/spring Paddy is cultivated during December to March. In the integration of prawn with Paddy, prawn culture is carried out during May to November, while paddy cultivation takes place during December to March. After paddy harvest, the entire paddy field will be filled with water at a depth of 1-1.5 m so as to enable the stocked prawn in the peripheral channels to invade the entire paddy field. Feeding is done with the help of locally available ingredients such as chicken viscera, rice bran, animal wastes, fish wastes, etc. Total harvesting is done after 7-8 months and the weight of the harvested prawn population varies from 30-190g with an average weight of around 80 g. The average production works out to be 400-500 kg/ha/8 months. Nguyen(1993), while reviewing the Paddy prawn culture in Vietnam stated that farmers will get as much from selling one kg of large (more than 70 g) prawn as from selling about 10 kg of paddy. Integration of prawn with paddy farming is also found ecologically sound and has also been proved to a very sound method of diversification in Mekong delta. Vegetable-prawn culture has also been reported in Mekong delta(Lin and Lee,1992) and culture of trees such as Banana, Papaya and Avocado are planted on pond dikes. Production of 500-600 kg/ha of prawn in six months in paddy fields with levees and platforms for producing cucumbers, string beans, eggplants and bananas is said to have provided a gross income four to six times higher than for paddy production. There are reports showing the production of two paddy crops with an average of 8.5 t/ha each and 400kg/ha of prawn. However, while the paddy, having only a domestic market, fetches only 20% of the cash income the prawn which accounts for 43% of the cash income, due to its export demand. The high valued cash crops with export potential cultured simultaneously contributed to another 33% of the cash income. The major bottlenecks confronting the expansion of the culture of prawn in this region are unsteady supply of prawn seed against the exponential demands made by the farmers, non-availability of local feeds within the financial abilities of the farmers, differential growth associated with the male morphotypes and the poor price structure of the under-size groups, capital constraints to organise culture activities among the middle level farmers, unstable farm gate prices to the produce due to the marketing deficiencies, etc.

Paddy -fish Culture : The collection of indigenous fishes from paddy fields is an age-old practice in Mekong delta. However, due to the heavy application of agrochemicals and pesticides, the environment became so hostile that a decline in the indigenous fish production is noticed in paddy fields. Consequently, farmers had shifted to the stocking of paddy fields with fingerlings produced in the hatcheries. The paddy-fish system with introduced fingerlings is practiced in bigger sized farms. In larger farms,

paddy -fish farming is done in part of the holding, while another part is exclusively set apart for monoculture of paddy. The major types of fish introduced in paddy fields are silver barb, common carp. Nile tilapia and silver carp. Fishes are generally stocked in paddy fields during the wet season crop and harvested after nine months. Pesticide application is found to be very less in rice-fish farming system and this system appears as the best example of Integrated Pest management System(IPM). The rice –fish integrated model is the most popularly applied farming system in Mekong delta. In this system, 70 to 90 cm deep channels are made around the rice field to hold water for fish culture. Fishes are stocked at a low density of 1-3 nos per m^2. Polyculture is also practiced with a combination of silver barbs (29%), common carps (24%), tilapia (12%), other fishes (11%) and freshwater prawn (16%). Total yield is in the range of 600-650 kg/ ha/yr. The channels are stocked with fish/ prawn in the months of April and nursery rearing is practiced for a period of three months. Once the rice cultivation is completed, entire pond is filled with water and the area is converted in to a fish farm. The grow-out operation is continued till the end of November. Predation by fish and poaching by humans and pollution from farm chemicals have been reported as major problems adversely affecting the fish culture in these provinces.

Integration of fish-paddy-crops, fish-paddy-livestock-crops: Chauthanh and Omon districts are two of the main districts in Cantho province where integration of aquaculture and agriculture, especially paddy –fish/prawn integrated system, paddy–livestock system and paddy-crop system are widely practiced. In a typical integrated system in the delta, garden-pond-cage, prawn-cum paddy, and live stock-garden crop practices are undertaken. For instance, in an area of one ha, 0.4 ha are used for raising garden trees and the rest for fish culture systems. The garden trees include mango, custard apple, orange, coconut and banana. These are located closer to the fish ponds. During high tide, water is available in plenty and it is pumped in to the ponds during summer season using diesel operated pumps. The intake water is filtered using bamboo screens and there exist inlet channels to deliver water in to fish pond. The average depth of the pond was 2 to 3 m. The cultivable fished like Pangasius Catfish (Pangasius bocourti and P. hypophthames) and giant gouramy was stocked at the rate of 10 to 15 nos. per m^2. Cat fish is fed with farm-made feed prepared using trash fish, chicken viscera, rice bran and broken rice where as giant gouramy is fed with grass leaves and vegetable wastes. A catfish production of 50 to 70 tonnes/ ha/year has been reported. Live stock available in the farm consists of pigs. In another integrated farming system Garden-fish pond-Cage-paddy are cultured together. Of the total area of 1.5 ha available for cultivation, the second farm utilised 1.2 ha for paddy-fish/prawn integrated culture and only 0.3 ha is kept apart for rice culture only. The garden trees comprising mango, plum, orange, coconut and banana are planted in an area of 0.12 ha, most of them on the banks of the paddy-fish ponds and paddy fields.

Fish Cage Culture

Angiang is a very well known province in Vietnam not only because of its paddy production but also because of fish production through intensive fish cage-culture. Located on the upstream area of the lower Mekong river, Angiang province is known for utilization of its potential for cage culture during the past five decades. Apart from serving as an ideal site for fish cage culture, the river also serves as a fish fingerling source for the culture industry. Traditional culture had its beginning on a small scale using wild procured fingerlings. The principal species used for cage culture are Pangasius catfish (*Pangasius borcoti* and *P. hythpothamus*), giant snakehead fish (*Channa micropeltes* and *C. striatus*), Nile Tilapia, Silver barb and Sand goby.. However, it has now expanded into an intensive fish culture industry with more than 10,000 cages of 200-1200m^3 each. With the great success achieved in seed production of these species during the past five years, cage culture is getting highly organised in this part of the country. The production registered from the cages thus works out to be around 60,000 tonnes/annum. The cages are made up of durable wood and steel. Oil drum, PVC pipe and bamboo logs are used as floats. Cages used here are having the sizes of 5 to 10m width, 10-20m length and 3-6m depth. Fish fingerlings are stocked at a density of 80-100 fish/m^3. Home-made feed, commercial pellet feed or trash fish are given daily at a rate of about 5% total body weight. Culture duration usually lasts for 240 to 420 days from stocking time, depending on sizes of fingerlings. Very high production of 20-100 tons/cage is normally obtained from the cages and the *Pangasius* catfishes are mainly processed for export.

In Thotnot, one of the districts of Cantho province, cage culture is practiced in a smaller scale. The number of cages set up is modest as the activity has developed only very recently . Fish cages set up here are usually small in size, having 3-5m width, 8-10m length and 2-3m depth. *Pangasius* catfishe such as *Pangasius borcoti* and *P. hypothamus* are two main species used for culture with density of 80-100 fish/ m^3. Red tail barb (*Puntius altus*) is also usually stocked at a low rate (5%). Home made feed is given daily @ about 5% of total bodyweight. Production ranges from 20-50 tons/ cage /12-14 months.

Shrimp Aquaculture

Total area brought under shrimp farming is around 200,000 ha during 2000 and the production registered is around 90,000 tonnes.At present around 400 shrimp hatcheries are functioning and around 12,000 million Pl are produced per annum. Over and above this, 30,000 million Pl are also imported from adjacent countries for meeting the total seed requirement .The most widely accepted candidate species is *Penaeus monodon*. However, *P.indicus* and *P.mergueinsis* are also preferred for culture.The major farming systems comprise improved extensive, semi-intensive, intensive,

shrimp-mangrove integrated farming and shrimp-paddy system is also adopted as an alternative integrated farming system. In shrimp-paddy alternative system, shrimp part of farming is carried out during February- July and thereafter (August) desalinisation is done in the paddy fields. The fields are later utilised for paddy cultivation from September to December and during January-February, ponds are prepared for facilitating shrimp culture during the months that follow. Shrimp farming is carried out following different methods such as improved extensive, semi-intensive and intensive farming and the production ranges fom 1 –4 tonnes/ha/140 days.

In Kien Giang province shrimp-mangrove integrated system is very popular. This system is emerging as a very promising solution for mitigating environmental problems to solve the deep conflicts that are going on between mangrove industry and shrimp culture. These conflicts resulted in the deforestation of more than half of mangrove area for the purpose of shrimp aquaculture since early 1980s in the Mekong Delta.

The shrimp-mangrove system is normally undertaken in an area of 3-5ha but the area may extend in some places to a range of 1-10 ha. Following the regulations of the government, the farms are covered with 60-70% mangrove and the remaining 40-30% of the area is used for making ditches for carrying out shrimp culture. In there ditches, shrimp are cultured at a density of 1-3 postlarvae/m^2. So far as feeding is concerned, home-made feed, commercial pellets and trash fish are supplemented. Average production of 300 kg/ha/season is normally obtained from this type of culture practice.

Relevance of Vietnamese *Aquaculture Technology in Kerala* : Kerala State, located on the south-west coast of India is endowed with a vast inland water resource comprising 243,000 ha of brackishwater lakes and backwaters, 3,300 ha of ponds, 85,000 ha of rivers and 30,000 ha of reservoirs. Besides, about 50,000 ha of paddy fields in the Kuttanad area located in Alleppey and Kottayam districts and 30,000 ha of Kole lands in Trichur are virtually lying fallow for all time or during most of the year. The waterspread of the reservoirs, rivers and backwaters are not at all judiciously utilised in spite of the fact that they are endowed with many suitable locations which are found ideal for undertaking different types of aquaculture activities. There exist these areas considerable scope for the development of freshwater aquaculture in general and the farming of the giant freshwater prawn *Macrobrachium rosenbergii* either as a follow up crop or as a main crop. Farming of this species in this area is now an emerging activity as the seed availability of *M. rosenbergii* has been picking up, of late, in Kerala. A renewed interest is perceived in the farming of this species either monoculture or polyculture in the fallow paddy fields, freshwater ponds, canals and homestead ponds of Kerala. *Macrobrachium rosenbergii*, the giant freshwater prawn, with the trade name Scampi and locally known as *Kuttanadan Konchu* or *Attu Konchu* has emerged as the most sought-after commercially cultivable species in Indian tanks and ponds, because of its faster growth rate, good demand in internal as well as export markets, and the premium price it fetches. Scampi supported a lucrative fishery of the order of 400 tonnes per annum in Kuttanad during early 1960s. However, during late 1980s production in this area dwindled to a mere 39 tonnes. The depletion of the stock of this species in Kuttanad is attributed to the impacts of various man-made changes in the ecosystem. When the seed production of this species became a reality in early 1990s on a semi-commercial level, a renewed interest towards augmentation of the resources by way of farming of the prawn in the fallow polders and derelicted water bodies of Kerala had been generated. The inherent problems faced by the farmers in the culture of this species are 1) The non-availability of required number of seed in the right time and 2) The low yield from the cultured population due to differential growth associated with male morphotypes. Although there are 60 prawn hatcheries are functioning with an installed capacity of 800 million seeds, the actual production from these hatcheries is only 20% of the installed capacity. In most of the hatcheries, production failures are regular features, resulting in the erratic supply of seed of the prawn.

Kerala Situation

South Vietnam and Kerala State of India are similar in agroclimatic conditions, fish farming systems, grow-outs characteristics etc. In both regions, *M.rosenbergii* constitutes a natural fishery, although, due to various human interventions, the catch is dwindling over the years. In Mekong Delta, integration of *Macrobrachium* culture with paddy is getting popularised at an exponential rate. In contrast, in Kerala, farming of *M.rosenbergii* is confronted with various inherent problems in both the regions such as non-availability of seeds in right time as per requirements, size heterogeneity associated with the male morphotypes and the low incomes from the farming system, low retrieval rate, etc. The problems are explained hereunder.

Institutional R&D support: In spite of the fact that Kerala is having great potential for development of inland aquaculture, it could not be tapped adequately for want of institutional support to fish farmers. At present, research institutions bestow perfunctory interest in assessing the problems associated with the existing fish production systems. Emulating the practices prevalent in Mekong delta of Vietnam where Cantho University plays a pivotal role in promoting various aquaculture activities, the research institutes should extend vibrant support to the Kerala farmers through identification and extension of ecologically and economically appropriate farming technologies suitable for different geographical regions of the State. Location-specific farming systems should

also be evolved in relation to species with market potential for tapping the farming potential of locations concerned. Monitoring of the impact of aquaculture and finding out solutions to various problems surfacing, finding out sources for the steady supply of seed and feed as per requirement of the farmers, transfer of innovative techniques to the farmers from time to time, are some of the issues which require top most attention of the institutions concerned.

***Transfer of Technology to the End-users through Training Programmes*:** At present no institution is offering demand-driven regular training programmes to the farmers who are involved in inland aquaculture. Transfer of technology through organising training programmes is a vital component in the promotion of aquaculture, as at AFSI of Cantho University in respect of the fish farmers of Mekong delta. It is high time to build up new centres with essential infrastructural capabilities for conducting such programmes.The prioritised areas for such type of training in Kerala are the larviculture of *Macrobrachium rosenbergii*, farm-made feed formulation of both prawns and shrimps, integrated farming of prawn-paddy -livestock-cash crops, fish- paddy integration, shrimp- paddy integration, larviculture of crabs, Vietnamese cage culture technology, ornamental fish breeding and propagation, captive breeding of indigenous food fishes, etc. Imparting hands-on training of Scampi larviculture would be helpful in the setting up of hatcheries at backyard level as in Vietnam. The seed availability against the ever increasing demand can only be met with by the proliferation of such backyard scampi hatcheries across the Kerala State. Development on these lines will inculcate a renewed interest in utilising the fallow and other suitable freshwater bodies for the purpose of Scampi culture. The hands-on training on feed formulation would eventually lead to the setting up of centers where prawn, fish and shrimp feeds can be produced from the locally available ingredients of animal and plant origin to cater to the requirements of farmers.

Cage culture potential of the State is not at all exploited and training in Vietnamese cage culture technology to Kerala farmers would be useful in providing another gainful vocation to them. Ornamental fish culture is emerging as another gainful activity for catering to both domestic and export requirements. Therefore, training on captive breeding techniques of indigenous and exotic ornamental fish species has to be imparted for helping the farmers in the setting up of their own units. Conducting of training programmes on various inland aqua-agriculture systems would also be useful for the farmers in making appropriate modifications in their farming systems, taking into consideration the locational advantages of the site available and also the need to enhance the productivity and sustenance by incorporating recent innovations.

***Setting up of Backyard Scampi Hatcheries using Vietnamese Technology*:** The Vietnamese technology of larviculture of *M. rosenbergii* is very simple when compared to the clear water system widely employed in India. The most outstanding feature of the modified static green water system adopted in Vietnam is that it requires only bare minimum quantity sea water and therefore, the setting up of the hatcheries even in interior places which are far away from sea becomes feasible. This is a blessing in disguise as much of the water bodies suitable for Scampi culture are located in the interior regions and these presently remain under utilised as seed of Scampi is not available in their proximity. The Vietnamese tecnology is further characterised by less of labour involvement, low technical input, short scouting period, and requiring no application of probiotics and antibiotics for production of healthy seeds. In Vietnam, the backyard hatcheries are managed by womenfolk of the family concerned without engaging any labour force. It would thus appear that farmers themselves can manage the hatcheries set up in their backyards after undergoing hands-on training under a professional in the line, if not under programmes organised by the government. In Kerala there is need to set up at least 500 such units for producing the needed quantity of scampi seed to facilitate full utilization of the culture potential. Majority of the units can be located in Alapuzha, Kottayam, Trissur and Palghat districts where the freshwater resources are abundantly available for scampi culture, when compared to the other districts in the State. These backyard hatcheries would provide avocation for gainful employment for at least 500 families of the farming sector of the state.

***Promotion of paddy - prawn/ paddy–fish Integration in the Paddy Fields*:** Monoculture of paddy is the typical culture practice prevailing in most of the places in Kerala with three crops per annum being raised in some of the fields. Paddy production has sustained a general set back due to the diminishing returns and also due to other confronting issues such as shortage of agriculture labour, crop loss due to flooding, pest menace, etc. The acreage of paddy fields lying fallow either fully for part of the year in the State is increasing from year to year. In Kuttanad, the rice bowl of Kerala, out of 55,000 ha of polders available, about 80% are lying fallow for about nine months, while 2000 ha have been abandoned as derelict water bodies. In Kole lands of Trichur, almost the entire 30,000 ha area is lying fallow almost round the year. The conditions of paddy fields situated in other parts of the State are also more or less the same. With the seed availability of *M.rosenbergii* now a days, some of the polders in Kuttanad are in the process of switching over for prawn culture. A dilemma however is that full conversion of paddy fields in

to prawn grow-outs cannot be advocated as such a development will adversely affect cereal food production of the State. In this background, the pattern of development of prawn culture in Mekong delta assumes significance for adoption in Kerala. Integration of paddy cultivation with either fish or prawn, as is being practiced in Mekong delta of Vietnam is very much suitable for adoption in Kerala. In Kuttanad, about 5000 ha are presently utilised for integrated fish and/or prawn aquaculture with paddy. Aquaculture of fish and/or prawn is however taken up after paddy harvest. This practice can be extended to the remaining polders and in other paddy fields of Kerala. The possibilities of integration of prawn and/or fish along with paddy cultivation as practiced in Mekong delta can also be attempted in suitable regions. In Kuttanad, paddy can be cultivated from November to February and Fish and/or prawn farming can be carried out from March to October. Concurrently, along with paddy cultivation, nursery rearing of the cultivable species can be done in small impoundments made in the same paddy field itself; and after paddy harvesting, the nursery reared stock can be released in to the entire field. The ideal species combinations would be Scampi as the main species, and grass carp for biological control, Indian major carps and the indigenous carps such as *Labeo dussumieri*, *Barbodes carnaticus*, *Gonoproktopterus thomassi*, etc., as the other species of culture.

Promotion of Paddy-fish-crop-live stock Integration in Paddy Fields: Integration of cash crop and live stock with paddy-fish combination would be another desirable proposition for the effective utilisation of the bund and other adjoining wet lands of the paddy fields. The bunds can be utilised for growing vegetables, banana, mango, coconut, etc of the water area while some portion can also be developed for erection of cages for accommodating live stocks such as duck, poultry, cow and pig. In some of the polders in Kuttanad, this system has already been introduced and this type of integration has the rare distinction of generating regular additional income to the farmers. Similar integration is also being widely practiced in Mekong delta, Vietnam.

Introduction of Vietnamese Floating Fish Cage Culture in Rivers, Reservoirs and Backwaters: In spite of the fact that Kerala is endowed with 44 rivers, 30 backwaters and 30 reservoirs, the cage culture potential of these water bodies is not being exploited. In this background, the introduction of Vietnam type of floating cages of 200 to 1000m^3 in the inland water bodies would lead to a breakthrough in the field of inland aquaculture sector of the State. To start with, cages of medium size can be set up in ideal locations where the minimum water depth is more than 4m i.e., Ashtamudi lake and Vembanad lake, and in rivers like Pampa, Periyar, and in some of the reserviors of the State. The down stream regions of Periyar river in between Chettuva bridge and Azhikode and the stretches between Barmouth and Arrokutty of Cochin Backwaters are very ideal for setting up cages for monoculture of *Lates calcarifer*. In other parts of Ashtamudi and Vembanad lake, the ideal combinations in cage culture would be Pearl spot, *Gerres filamentosus*, milk fish, *Lutjanus argentimaculatus*, and *Macrobrachium rosenbergii*, and several others. The desirable candidate species for Vietnamese types of floating cages in the freshwater bodies would be a combination of Indian major carps, indigenous carps such as *Labeo dussumieri*, *Gonoproktopterus thomassi*, *Barbodes carnaticus*, *Tor khudree*, etc. The production performance of these fishes in cages will have to be evaluated and the environmental impact will have to be assessed. Based on the results so obtained, establishment of 'cage villages', similar to those of Mekong delta, Vietnam can be attempted.

Integration of Mangrove-shrimp Aquaculture: Mangroves are known as breeding and nursery grounds of marine and estuarine organisms. Mangroves serve as ideal feeding and breeding grounds for some of the commercially important fin and shellfishes. The total extent of mangroves in Kerala was quantified as about 70,000 ha two decades back. The shrinkage was however estimated to be in the order of 70 ha recently. Integration of shrimp farming with mangroves has been found to be the most sustainable type of aquaculture. Apart from providing food and shelter for the cultured organisms, mangrove vegetations functions effectively for the removal of wastage generated in the shrimp ponds and in maintaining hygienic water conditions. In Vietnam, shrimp aquaculture is undertaken in harmony with mangrove ecosystem. Shrimp grow outs are constructed in that country without causing any damage to the mangrove ecosystem. This system, therefore, would be appropriate for the conditions of existence in Kerala and for the protection and preservation of the available mangrove areas in the State. This recommendation should find a place in the impending fisheries policy of the Government of Kerala.

National Seminar on HRD in Fisheries and Aquaculture for Eastern and North-Eastern India (14-15 March, 2002)

Central Institute of fisheries Education, (Deemed University), Kolkata Centre is organizing a two day National Seminar on the topic 'Human Resource Development in Fisheries and Aquaculture for Eastern and North Eastern Inda' during 14-15th March 2002 at the Central Institute of Fisheries Education (Deemed University), Kolkata Centre, Indian Council of Agricultural Research, 30-GN Block, Sector - V, Salt Lake City, Kolkata-700091 (W.B). Concurrently, an Exhibition of fisheries interest will be held at the same venue. Over 200 fisheries scientists instructors of various fisheries training organisations, private fish culturists and several other professionals, students etc., will be participating in the seminar to exchange their ideas to develop different sectors of fisheries and aquaculture industry. Besides, the event would be an ideal platform to negotiate ties-up, collaboration, and for buyers and sellers for arriving at business deals.

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The Chennai Declaration on Sea Safety for Artisanal and small-scale Fishermen

The workshop on the captioned subject was held in Chennai from 8th to 12th October 2001. The Chennai Declaration was adopted by participiants from Bangladesh, India, Indonesia, Malaysia, the Maldives, Srilanka and Thailand, at BOBP/FAO Regional workshop on 12th October 2001 are enumerated as follows:

Conscious that fishing is the world's most dangerous occupation with more than 24,000 deaths per year attributable to weaknesses in the institutional and regulatory environment, a declining resource base, and poor socioeconomic conditions in the sector;

Realizing that sea safety regimes are weakest amongst the artisanal and small-scale fisheries sectors, particularly in developing countries;

Realizing that more than 80 per cent of the world's artisanal and small-scale fisheries are concentrated in Asia, where many of the coastal target stocks are over- or fully exploited;

Recognizing that the consequences of loss of life fall most heavily on the surviving families, for whom alternative sources of livelihood may not exist;

Concerned about the inadequacy of social and political will to address the issue of fatalities amongst artisanal and small-scale fishermen;

Accepting that the issue of safety for the artisanal and small-scale fisheries sectors is not fully recognized, or acknowledged, by fisheries policy objectives and further, that the focus is more on economic and resource management issue than the safety of artisanal and small-scale fishermen;

Concerned that current fisheries management regimes for coastal fisheries in the region may lead to increased levels of operational risk for artisanal and small-scale fishermen;

Concerned that safety measures, together with supporting regulations and standards relevant to the needs of artisanal and small-scale fisheries sectors, remain inadequately addressed by fisheries and maritime administrations in the region;

Recognizing that neither the Torremolinos International Convention for the safety of Fishing Vessels, 1977, as amended by the 1993 Protocol, and the 1995 Convention for the Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel are in force, nor are they applicable to fishing vessels under 24 metres in length;

Recognizing the limitations in institutional capacity of fisheries and maritime administrations in the region to undertake all responsibilities associated with their mandate;

Realizing that fishing operations are carried out in a hostile and hazardous environment from vessels often having weaknesses in their design, construction and equipment, thus being prone to failure;

Accepting that fishermen in both traditional and diversified fisheries are exposed to inherently high levels of risk and resulting accidents, for which there are few survival or rescue strategies;

Emphasizing the urgent need to address the multi-dimensional issue of sea safety for artisanal and small-scale fishermen on a regional basis and in a holistic manner; and

Recognizing that the problem is not insurmountable;

We, the representatives of Fisheries and Maritime Administrations, Coast Guard/Navy and Fishermen's Associations, nominated by the Governments of Bangladesh, India, Indonesia, Malaysia, the Maldives, Srilanka and Thailand, having participated in the BOBP/FAO Regional Workshop on Sea Safety for Artisanal and Small-scale Fishermen held in Chennai, India form 8th to 12th October 2001, now therefore:

Resolve to address, as a matter of urgency, the issue of safety at sea for artisanal and small-scale fishermen;

Recommend that sea safety issues be comprehensively integrated into member country's fisheries policy and management frameworks. This would include associated commitments under the Code of Conduct for Responsible Fisheries and other regional, inter-regional or global instruments and initiatives;

Recommend measures, which would result in a harmonized and holistic fisheries management framework for the Bay of Bengal;

Emphasize the need to rationalize institutional mandates, legislation, regulation and enforcement at the national level, in order to enhance sea safety in artisanal and small-scle fisheries;

Ensure the incorporation of FAO/IMO/ILO Voluntary Guidelines for the Design, Construction and Equipment of small Fishing Vessels and the FAO/IMO/ILO Document for Guidance on the Training and Certification of Fishing Vessel Personnel into regulatory frameworks, as appropriate;

Recommend that fisheries and maritime administrations enhance their knowledge of the operations and constraints of the artisanal and small-scale fisheries sectors in order to formulate effective guidelines, standards and regulations for the safety of fishing vessels, inculding the certification and training of crews;

Recommend the development and implementation of education, training and awareness programmes, which satisfy regulatory requirements, while also building a culture of sea safety within artisanal and small-scale fishing communities;

Recommend that mandatory requirements for improving sea safety be supplemented by other strategies, which imvolve the participation of the fisher communities, families, the media, and other stakeholders in order to promote the adoption of a wide renge of safety measures;

Recommend that member countries undertake measures directed towards ensuring enhanced economic viability of artisanal and small-scale fishing enterprises as an essential element of the sea safety issue;

Recommend that administrations consider the provision of financial and other incentives to encourage and ensure the widespread use of safety equipment, together with training in the use of such equipment;

Recommend that a programme of applied research and development be initiated, focusing on the development of cost-effective safety-related equipment relevant to the needs of the artisanal and small-scale fisheries sectors;

Strongly recommend the formulation and implementation of a regional sea safety programme, employing a consultative and participatory derived data, together with the operationally experience of artisanal and small-scale fisher communities;

Recommend that the issue of sea safety be addressed on an urgent basis. This could be achieved through a regional mechanism such as the Inter-Governmental Organization processed by the BOBP member countries during the 24th meeting of the BOBP Advisory Committee at Phuket, Thailand.(The Phuket Resolution - October 1999);

Agree to seek the support of the donor community for the development of a sea safety programme, and also request FAO to seek such assistance on our behalf.

(Reproduced from Samudra, No.30, Dec. 2001)

Construction of Mahseer Farm in Himachal Soon

The construction of Mahseer Farm in Himachal will be taken up soon, the State Director of Fisheries said while addressing the anglers at the Trout Angling meet at Larji recently. Large scale seed ranching of Mahseer in suitable streams has not been for want of a Farm to raise the hatchery produced young ones to yearling stage that it is said that the central government released Rs. one crore as the first instalment out of Rs. four crore of central share, but the project has been help up as the state Government' share of the similar amount has not been released in the past of few years. States share is expected to be released soon.

It is noteworthy that the site proposed for the farm is subject to floods and it is also said that that a major amount of the estimated cost only would be needed mainly towards protection works against floods. It is expected that the selected site would be developed and construction would commence as per the design finalised by the fisheries department very soon.

Satyabrata Sahu : New Director of Fisheries, Orissa

Mr. Satyabrata Sahu, I.A.S., has taken over as Director of Fisheries, Orissa recently in the place of Mr. Gagan Kumar I.A.S. transferred

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Immunostimulants and their role in Aquaculture

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In recent years aquaculture production has increased rapidly in the major producing countries of the world; In fact, fish and shrimp farming represents the fastest growing segments of the animal production industry, with annual increase in production exceeding a value of 10% in many countries. Even though there is an increase in production, there has been reports of a large number of outbreaks of diseases among fish and shrimp under culture. Hence the health management services and products have a vital role to play to increase the production efficiency. Fishes and prawns are very much susceptible to disease as the pathogens occur naturally in environment and may cause disease if the animals are under stress. Hence, it is very important to adopt proper culture practices to keep an equilibrium among three major factors i.e., pathogens, environment and host susceptibility.

In farm conditions, it is difficult for the farmers to identify and correct a primary stress condition; hence the option that is resorted to is to eliminate the pathogen but this is very difficult. Mostly antibiotics are used for this but the problem with their use is that their indiscriminate use will result in the evolution of resistant strains of bacterial pathogens. Further residual effects of antibiotics in fish and shrimp are regarded as hazards for humans. Hence the indiscriminate use of antibiotics is highly dangerous.

Vaccination is another prophylactic measure adopted for the prevention of disease; but only three vaccines are commercially available for fish. These are: Vibriosis vaccine, Enteric red mouth vaccine and Farunculosis vaccine, and none are available for shrimp for the reason that the immune system in shrimp is different from fish. Fish immune system does not have memory like other vertebrates, in which, once antibodies are produced in response to an infection, the same antibodies come into play in subsequent infection by the same pathogen; but in the case of shrimps, they lack memory and rely on a non-specific defence system which reacts to infection as it occurs and disappears after that. Hence, use of vaccines on shrimps would not have any effect. In view of this, the best method that can be adopted is to strengthen the immune system of shrimps. This is enabled by immunostimulation. Immunostimulation also helps in toning up the immune system of fishes.

Fish Immune system

The defence mechanism in fish is not as developed as in higher vertebrates like mammals; and the mechanism in mainly divided into two: 1) The specific defence mechanism; 2) Non-specific defence mechanism.

The specific defence mechanism, as the word implies, is specific towards the foreign bodies and is characterised by the initial interaction of the antigen and lymphocytes. Antibodies or immunoglobulins (IgS) are created in the blood against specific foreign bodies. Unlike the other vertebrates, fish produces only one Ig which is tetrameric in structure. Cell mediated immunity is imparted by T lymphocytes, which produce soluble lymphokines that activate macrophages monocytes to enhance their ability to kill intracellular pathogens.

Non-specific defence mechanism is the first and the most important mechanism that comes into play in fish defence mechanism. Its coverage includes physical barriers like skin, scales and mucus, enzyme like lactoperoxidase in saliva, lysozyme in mucus and other gastric juice secretion and tissue, phagocytic cell (macrophages and neutrophils) and blood proteins.

IMMUNOSTIMULATION

Immunostimulants are compounds, which affect the non-specific defence mechanism and specific immune response of fish. In many cases the mode of action of these substances in fish is either uncertain or unknown. There are about 20 different compounds which have been identified as having potential use in immunostimulation. Fish depends more heavily than mammals on non-specific defence mechanism and therefore, immunostimulants have a significant role to play in health management strategies in aquaculture. Some of these are cited below.

Immunostimulants and Adjuvants and their mode of Action

A list of Immunostimulants and Adjuvants and their mode of action is furnished hereunder:

- Complete Freunds Adjuvant (CFA): Antigen reservoir, T-lymphocyte stimulator.
- Incomplete Freunds Adjuvant (IFA): Antigen reservoir.
- Muramyl dipeptide : T-lymphocyte stimulator.
- Levamisole : T-lymphocyte stimulator.
- FK-565 (*Streptomyces olivaceogriseus* derivative): T-lymphocyte stimulator.
- Glucans : Macrophage activator.
- ISK (Fish and product derivative): unknown.
- Chitin and chitosan : unknown, may be similar to glucan.
- Ete (tunicate derivative) : Phagocy-

tosis.

- Vitamin C (ascorbic acid) : Antioxidant, multiple cell stimulator.
- Vitaman E (α - tocopherol) : Antioxidant, B-and T-lymphocyte stimulator.
- Bacterial endotoxins : B-lymphocyte stimulators.
- Quarternary ammonium compounds : unknown.

Immunostimulants rarely occur alone in natural environment but are very much important for aquaculturists as they, along with adjuvants, are useful in preventing fish diseases especially in intensive culture systems, pens and hatcheries. Now a days extensive research work is taking place on some immunostimulants like glucan, chitin, levamisole, bacterial lipopolysaccharides and light oils.

Glucan derived from yeast cell wall and certain higher plants, when injected or fed to fish, has shown good immunostimulant properties. It could stimulate the non-specific defence mechanism of fish. In Rohu *(L. rohita)*, yeast glucan, when introduced, enabled enhancement of phagocytic activity of leukocytes and stimulated generation of reactive oxygen species (ROS) in phagocytes. When glucan was administered along with a hydrophyll vaccine, the response was enhanced further. Yano *et al.* (1991) showed that β-1,6 branched β-1,3 glucan were effective in common carps *(C. carpio)*. Further studies have shown that glucan treatment was effective in Atlantic salmon against *Vibrio salmonicida* and yeast glucan in channel cat fish *Ictalurus punctatus* against *Edwardsiella ictaluri* (Chen and Ainsworth, 1992). Even in shrimps like *P. monodon* immunostimulation by glucan has been reported by Song *et al.* (1994). Robertson *et al.* (1994) summarised their studies with β-glucan as it increases the non-specific resistance of fish against infections of bacterial pathogens.

Administration of Chitin derivative chitosan to Brook trout *(Salveleinus fontainalis)* by injection/immersion has been found to give high protection against *Aeromonas salmonicida* up to 3 days but later the protection came down by 14th day (Anderson and Siwicki, 1994). Injection of chitosan is preferred to simple immersion.

The non-specific immune stimulants are effective on short-term basis because the specific immune response is not involved.

Vitamin C and E have also shown immunostimulation properties. Levamisole, an antihelmenthic drug, has also shown immunomodulatory properties. Apart from these immunostimulants there are many others like muramyl dipeptide, quarternary ammonium compounds and various animal products such as ISK and immune stimulatory complex from fish and tunicate extracts have shown immunostimulating properties.

Conclusion

With the alarming increase in human population and land area remaining the same for cultivation, there has been immense increase in demand for aquaculture products and other fishery products as a source of food. With new intensive cultural systems and seed production techniques the outbreak of disease occurrance has also increased. Chemotherapy has not always being convincingly effective in controlling disease, nor the use of antibiotics which has resulted in the evolution of resistant strains of bacterial pathogens. In this situation new prophylactic measures like use of immunostimulants have a vital role to play in the control of diseases and to increase production. There has to be a lot more to be done in this field, in the direction of research and to commercialize the immunostimulants developed.

References

1) ANDERSON, D.P. and SIWICKI, A.K. (1994). Duration of protection against Aeromonas salmonicida in brook trout immunostimulated with glucan or chitosan by injection or immersion. *The Progressive Fish-Culturist* **56:** 258-261

2) CHEN, D., and AINSWORTH, A.J (1992). Glucan administration potentiates immune defence mechanisms of channel cat fish, *Ictalurus punctatus Ra*finesque. *J.Fish Dis.* **15:** 295-304

3) ROBERTSON, B., ENGSTAD, R.E., and JORENSEN, J.B (1994). β-glucan as immunostimulants in fish. In . "Modulators of fish immune responses : Models for environmental Toxicology, Biomarkets, and Immunostimulators" (J.S. Stolen and T.C. Fletcher, eds), : SOS Publications, Fair Haven, Nj. pp. 83-99.

4) SONG, Y.L. and HSIEH, Y.T. (1994). Immunostimulation of tiger shrimp *Penaeus monodon* hemocytes for generation of microbicidal substances: analysis of reactive oxygen species. *Dev. Comp. Immunol.* **18**: 201-209

5) YANO, T., MATSUYAMA, H., and MANGINDAAN, R.E.P. (1991). Polysaccharide induced protection of carp, *Cyprinus carpio,* against bacterial injection. *J. Fish Dis.***14**, 577-582.

Water Testing Kits Subsidised by MPEDA

It is learnt that MPEDA has formulated a proposal to provide a subsidy of 25% on water testing kits, which presently costs Rs.1.21 lakhs to enable aquaculture farmers to acquire them. This kit comprises equipments like dissolved oxygen meter, saline refractometer, soil pH tester, water testing pH meter, seechi disc and equipment for analysing Hydrogen sulphide, Ammonia, Nitrate and total Alkalinity.

Further details can be obtained from MPEDA Regional/ Sub-Regional Centres or the Joint Director, Aqua, MPEDA Head Office, Parampally Avenue, Kochi - 682 036, Ph.317762.

Thapar Group Ahead: Receives Award from VEPZ

The Waterbase Ltd., a company promoted by Thapar Group with an export turnover of Rs.38.00 crores during 2000-2001 has been awarded third prize for its achievement in Aquaculture sector for the year 2000-2001. It is a leading 100% EOU aquaculture unit in Andhra Pradesh.

Fish Diseases in Punjab : Present Status and Challenges Ahead

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The fish farmers of Punjab stole a march in their achievements in fish culture over their fellow farmers in several States having the tradition of fish culture for long. A late entrant into the profession of fish farming, the State of Punjab made a remarkable progress in a short duration of around two decades. Punjab is now reckoned as one of the important fish producing States, adopting developed technologies, and modifying them with innovations made by its resourceful farmers. There has been a progressive increase in the area brought under fish culture and also in respect of fish production from year to year. The State of Punjab produced 49,500 mt of fish in 2000 - 2001 against 45,200 mt 1999 - 2000; 44,500 mt in 1998 - 99 and 36,000 mt in 1997 - 98. The area under fish farming increased from 4,098 ha in 1997 - 98 to 5,078 ha in 1998 - 99 and to 5,940 ha in 1999 - 2000. Although, average fish productivity in Punjab is over 4 t/ha/yr, some of the farmers harvest up to 8 t/ha/yr. These high yields have been achieved by adopting intensive farming techniques, which involve high stocking density, use of supplementary feeding, application of fertilizers, etc. However, these intensive farming techniques have also increased the risk of disease outbreak. In fact, disease is caused when the delicate balance between the fish, its environment, and the pathogenic organisms living in the pond get disturbed. Many pathogens viz., bacteria, viruses, protozoans, helminths, crustaceans, etc., are ever present in a fish pond and they attack the fish only when fishes get subjected to stress. Stress conditions are caused by unfavourable environment and overcrowding of the fish in a pond, although genetically vigorous stocks may be resistant to some diseases. Major carps afflicted with diseases are, however, come across in the State occasionally. However, this reassuring general picture faces the threat of the recent inroads made by African catfish, *Clarias gariepinus*. Culture of this catfish is banned by the ICAR and the State Government. Despite the ban, its culture has been adopted by several farmers in the State. This fish is highly susceptible to diseases. This risk is compounded as farmers feed them with uncooked chicken and other animal wastes, which can impart infection. There are possibilities of transmission of these diseases to carps under culture in nearby ponds through fish eating birds. This may happen sooner or later resulting in an acute fish disease problem in the near future. In order to maintain the present higher production rates, and improve upon them, it is high time to institute needed precautionary measures to avert disease incidence among cultured fishes in the State.

Common Fish Diseases

Some of the common fish diseases observed as at present in Punjab are described below:

A. ***Haemorrhagic Septicemia and Saprolegniasis***: Haemorrhagic septicemia has been found to affect *Labeo rohita* and *Cyprinus carpio* in winter in ponds with heavy loads of organic manures (24t/ha/yr or more) when water temperature dips below 18°c. The disease has been found to be caused by *Aeromonas punctata*. *L. rohita* has been found to be more susceptible to this disease than *C. carpio*. In *C. carpio*, the disease remains restricted to early stages (redness of the lips, barbels, bases of fins and margins of eyes, and scattered red spots on the operculum and dorsal and ventral surfaces of the body), which does not lead to the death of the fish. In *L. rohita*, however, the red spots on head, bases of paired fins, and dorsal surface of the body develop into dermal lesions leading to the formation of red ulcers with gray margins. This stage is followed by an extensive haemorrhagic necrosis (Toor *et al*., 1983). The higher susceptibility of *L. rohita* to HS than that of *C. carpio* as noticed by us, somewhat differs from the observations of Bauer *et al*., (1973). According to them *C. carpio* is more susceptible to HS than any other species cultured in the same pond.

Soon after their formation, (20-24 hours), the ulcers on the affected fish provide substratum for the growth of a cotton wool like fungus, *Saprolegnia parasitica*, causing saprolegniasis. The growth of the fungus leads to an extensive fin-rot. The affected fishes exhibit abnormal behaviour and succumb to the infection after two to three days.

B. ***Epizootic Ulcerative Syndrome***: Epizootic Ulcerative Syndrome (EUS), also referred to as Ulcerative Disease Syndrome (UDS), is a serious infectious disease which has been observed to occur in Punjab. Both Indian major carps and Chinese carps are affected by this disease. The disease was first noticed in Atlantic salmon and sea trout in 1911, in England. The first authentic case of EUS was detected in Australia in 1972 followed by Papua New Guinea in 1975. The disease was later reported from Thailand, Indonesia, Philippines and Indo-Pacific region in 1980s. The epidemic reached Sri Lanka and Bangladesh in 1992. It entered Assam State from Bangladesh via Barak valley in 1993 (Tika Ram, 1993)

There is some confusion regarding the primary causative agents of this disease. It has been reported that, though the pathogenic organisms isolated from

the affected fish indicate virus, bacteria, and fungus, none of these could be conclusively proved as the primary causative agent. However, Tika Ram (1993) has confirmed the presence of *Myxobolus cerebralis, M.cartiliginis,* and *Thelohanellus pyriformis* in all the fifty samples of affected fish (Indian major carps) from Harayana and concluded that these were the causative agents of the EUS.

At the time of the severe outbreak of the EUS disease, the fishes congregate at the surface of the pond, and exhibit abnormal behaviour such as rapid swimming with their heads out of water. The red spot lesions, which are typical of the disease, are found on the body of some of the more susceptible fishes. Large and deep ulcers are found on the body of the affected fish. Advanced ulceration sometimes erodes deep into the muscles and show fin-rot. Some fishes undergo head erosion.

C. ***Necrotic Dermatitis***: This disease has recently been observed in a catfish, *Rita rita* collected from Rajasthan and Ferozpur feeder canals originating from Harike barrage in Ferozpur district of the State. The disease was observed in summer months (April to May, 2001) when the water temperature was recorded to vary between 29 to 32° C. The water was grossly polluted by the discharge of industrial effluents. The pH of the water was recorded to vary between 6.5 and 7. The other fish, which showed some signs of the disease, was *L. rohita.* The primary causative agents of this disease have been found to be *Cocci* and *Diplococci.* The fish suffering from this disease have dermal necrosis in the head and the snout regions. The necrotic part of the skin provides substratum for the growth of a fungus, *Trichosporan cutaneum.* This disease, like HS and EUS, is also a killer disease.

D. ***Argulosis***: Argulosis, which is caused by a crustacean ectoparasite, *Argulus*, has also been observed affecting fishes in Punjab. The most commonly affected fishes are Indian major carps. Amongst the Indian major carps, *Cirrhinus mrigala* is the most susceptible one. The parasite attaches itself to the body of the fish and sucks its body fluids. Consequently, the fish loses its appetite and its growth is adversely affected.

Treatment

No serious attempt has been made to manage different kinds of fish diseases in Punjab. In fact, there has not been any systematic approach to investigate, diagnose, and treat fish diseases in the State. The main reason for this is that the disease had not been a serious problem as only semi-intensive culture was undertaken in fish ponds of Punjab until quite recently. With the shift by way of upgradation to intensive culture system adopted by most of the farmers, disease problem surfaced. *A.punctata*, which has been isolated from the fishes suffering from HS has been found sensitive to some antibiotics like ampicillin, teramycin, and tetracycline (Toor *et al.*, 1983). Similarly, *Cocci* and *Diplococci,* causing necrotic dermatitis have been found to be sensitive to a wide range of antibiotics. Some systemic drugs like furazolidone and stovarsol have been found to be promising antidotes against myxosporidians causing UDS (EUS) (Tika Ram, 1993). However, there is no information on the effective doses for application of these drugs and the period and the method of their administration. The Central Institute of Freshwater Aquaculture (CIFA) has come up with a drug under the name of CIFAX, which is claimed to be effective against EUS. Copper sulphate @ 12.5 kg/ha is being used by the farmers for the control of bacterial diseases in fishponds without any scientific basis. Similarly, metacid @ 2.5 L/ ha has been found effective against argulosis, but there are no scientific data to support these treatment practices.

Recommendations

Keeping in view the adoption of intensive fish farming techniques, which increase the risk of disease outbreak, and also the increasing incidence of fish diseases in fish ponds in the State, it is high time to pay attention towards a systematic approach to investigate, diagnose, and treat fish diseases so that the higher yields of fish could be maintained. There is a need to establish a well equipped Fish Pathology Laboratory in Punjab. A systematic survey of fish diseases prevalent in the fish farming ponds of the State needs to be conducted. The effective doses of the various drugs to which pathogens have been found to be sensitive need to be worked out, and the methods and periods of drug administration need to be standardized. The selection of the antibiotics has to be done carefully to avoid its bioaccummulation in the fish and ultimately in the humans. Many plant products like turmeric (*Curcuma longa*) and neem leaf (*Azadirachta indica*) have been shown to be effective in the management of bacteria infection of African catfish (Chakraborty and Chattopadhyay, 1998). Such products need to be tried for other farmed fish under diverse climatic conditions. Similarly, advanced methods of drug administration like oral vaccination including biofilms of pathogenic bacteria (Azad *et al.*, 1999), and use of monoclonal antibodies (Shankar *et al.*, 2000) need to be developed and standardised for the local conditions and fish species.

References

AZAD, I.S. SHANKAR, K.M. and MOHAN C.V., 1999, Are biofilms of pathogenic bacteria promising as oral antigens in fish vaccination?, *Fishing Chimes*, **19** (3) : 25-27.

BAUER, O.N., MUSSELLUS, V.A. and STRELKOV, Yu. A., 1973, Diseases of Pond Fishes, Israel program for Scientific Translations, Jerusalem, 220 pp.

CHAKRABORTY, C. and CHATTOPADHYAY, A.K., 1998, Turmeric (*Curcuma longa*) and neem leaf (*Azadirachta indica*) extract in the management of bacterial infection in African cat fish, *Clarias gariepinus* (Burchell). *Fishing Chimes*, **18** (8) : 25-27.

SHANKAR, K.M., MOHAN, C.V., ANIL, T.M., and VIDHYA, R., 2000, Monoclonal antibodies in fish and shell-fish health management. *Naga*, **23** (4) : 10-12.

TIKA RAM, S.M., 1993, UDS : Killer disease of fish. *The Tribune*, 27 May, 1993.

TOOR, H.S., SEHGAL, H.S., and SEHDEV, R.S., 1983, A case study of acute fish diseases in tanks loaded with high levels of organic manures. *Aquaculture*, **35** : 277 - 282.

Breakthrough in Grass Carp Breeding in Sikkim

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Sikkim has approximately 900 km of riverine fishery resources, 32 sq miles of temperate lakes and innumerable springs and streamlets passing through villages. Rivers are the main source of fish production in the State, but fishing in rivers is carried out in a very limited and scattered manner. The temperate lake resources are yet to be exploited. Virtually no fish culture practice is being followed in the State for the simple reason that the farmers had no knowledge of fish culture and probably because of the presumption that fish culture is not viable in hill State like Sikkim.

Unlike in the plains, natural ponds do not exist in villages but ponds could be constructed wherever there is sufficient water flow from spring and stream sources. The State Fish Farmers Development Agency has been advocating fish culture in such places for the past sometime. The technology of culture of two species viz., grass carp and common carp, based on experience in Government farms is being transferred to the villagers covered under FFDA scheme. The fish seed of common carp is supplied to the farmers from government farms but the seed of grass carp is being imported for the past few years from outside the State, because of unsuccessful efforts at breeding of grass carp in the government farms. It is in this context that the author took up the challenge and successfully experimented on induced breeding of grass carp at Rothak Fish farm in West Sikkim. This was the first success in breeding of grass carp in the State. However, the technology of facilitating hatching of eggs, development of spawn into hatchlings/early fry and rearing them into fingerlings in nursery ponds needs immediate attention for standardization so that maximum no. of seeds can be obtained.

The condition of fish brooders and factors like water temperature and pH that prevailed at the time of successful breeding are given hereunder which may be informative and useful to fishery workers in all hilly region of the country.

Experiment

Grass carp spawners were selected for induced breeding on 5 May 2001. The breeding was undertaken in breeding hapa for one set and in breeding pool for three sets. The breeding hapa was fixed in a cistern tank and constant water flow was maintained in the surface area. In the breeding pool, a circulatory water flow and aeration by water spray were provided. The brooders were collected from brooder tank and kept in a cistern tank for six hours for conditioning. The brooders of four years age group weighing 3 kg on an average were selected for the experiment.

A new inducing agent called OVATIDE promoted by Hemmo Pharma, Mumbai, was used for injecting grass carps to induce them to breed. A single dose of Ovatide hormone at the rate of 0.4-kg/body weight to 4 females and 0.2 kg/ body weight to 4 males were injected in the caudal peduncle region of the fish. After injection one set was kept in the breeding hapa and other three sets were released in the breeding pool. The water temperature in the cistern and pool was recorded to be 25° C after injection at 6.00 p.m. on 30 May 2001.

No breeding movement was observed even after 15 hours of injection. Normally the breeding takes place after 8 hours of injection in other places. The brooders were than taken out from the hapa at 9.00 a.m on the next day (31 May) when the temperature of water was recorded to be 24° C. On checking, it was observed that the female was ready to release eggs and the male released milt easily on slight pressure in the belly. The stripping of female and male was done and the eggs were fertilized following wet method. After water hardening of the fertilized eggs of one set, the eggs were counted by volumetric method. The eggs numbering 5,08,000 were obtained from one set. After one hour the brooders in the breeding pool also started showing breeding movement. The fertilized eggs from breeding pool started moving into the circular hatchery after 2 hours. The number of fertilised eggs retrieved from breeding pool could not be counted as the eggs flowed directly through internal pipe system. The counted eggs were placed in the circular hatchery and constant circular water flow was maintained. The hatching of the eggs started at 3.00 p.m. on 1 June 2001. The incubation time was recorded to be 30 hours at a temperature range of 21° C to 25° C. The pH of water was recorded to be 7.0 to 7.2.

Although the induced breeding of grass carp was successful for the first time in the State, the hatching of the eggs was partly successful because of silt laden water which entered the hatchery on the night of 31 May 2001 due to heavy rain.

While a breakthrough has been achieved in the induced breeding of grass carp, the need is felt to conduct another experiment to achieve complete success in hatching and nursery practices as well. This successful induced breeding of grass carp in the mountainous conditions of Sikkim, however, represents the first step in the production of grass carp seed for distribution to the fish farmers.

Conclusion : The successful breeding of grass carp is a milestone in the development of fish culture in Sikkim, achieved by FFDA, Sikkim. While a reassuring beginning has been made for mass production of grass carp seed, there is a next challenge to face in respect of standardizing the hatching and nursery work that suits the conditions of the hill State.

In the 8th and 9th five year plans, increase in fish production in the State, though insignificant, could be achieved. However, quality in production has come only from FFDA scheme. Fish production from riverine resources is not expected to increase any more. But there was always a reservation that production of fish from FFDA ponds may not continue for long in the absence of local production of grass carp seed. This fear is no longer there with the successful breeding of grass carp. Way is now paved for sustained fish production from ponds developed under FFDA scheme and an avenue has been opened for increasing fish production from other sources like seasonal ponds and paddy fields too.

Acknowledgement : The author is thankful to Mr. S.T.Lepcha, in charge of Rothak Fish Farm, West Sikkim for providing the brooders and for his active association and support during the course of the experiment. Thanks are due to farm staff who worked day and night for the success of the experiment.

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Radiation Processing for the Control of Biohazards in Aquaculture

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As compared with capture fisheries, aquacultured fish and shellfish are closer to biological and chemical hazards due to possibilities of their contamination through agents from both freshwater and coastal ecosystems. The biological hazards include parasites, insects, pathogenic microorganisms and viruses. Consumers in several Asian countries have the habit of eating raw or partially cooked fishery items. Therefore with enhanced export potential of several aquacultured species there is need for implementation of HACCP concept along with newer processing techniques in order to protect the consumers against the hazards. The safety issues associated with aquacultured products have been recently highlighted by a Joint FAO/ NACA/WHO Study Group. Exposure of foods to ionizing radiation is an emerging technology to improve the hygiene of a variety of food products, both of argicultural as well as animal origin. This contribution is intended to briefly discuss the various biological hazards associated with aquaculture operations and the scope of using ionizing radiation in countering the problems. The recent Gazette notification by the Government of India permitting irradiation of fishery products could be a boon for the improvement of quality of aquacultured fish and shellfish both for domestic consumption as well as export.

Biohazards and Safety Issues in Aquaculture

Zoonoses : A large number of fish species, both marine and freshwater, are potential sources of important parasitic zoonoses. Some of these zoonoses are highly pathogenic. The principal human diseases are trematodiasis, nematodiasis and cetodiasis, which are caused by consumption of raw or uncooked fish. Fish-borne trematodiases are important diseases in various parts of the world, causing morbidity and complications leading to death. The cause of infection is the ingestion of viable encysted trematode metacercariae, which can be present in the flesh of raw, inadequately cooked or minimally processed freshwater fish. The two major genera of importance for human health are *Clonorchis and Opisthorchis*. Clonorchiasis, caused by *Clonorchis* is endemic in some countries of East Asia. The larvae of *C.sinenis* multiplies in snails and the released free swimming cercariae penetrate and form cysts in fresh or dried fish muscle, where it can persist for a considerable time. When ingested by humans, the clonorchis metacercariae exit into the small intestine and migrate to the bile duct, where they cause clinical disease. The cercariae can be killed by adequate cooking.

Marine mamals, birds and pig are natural definitive hosts for nematodiases whose second intermediate hosts are fish of diverse origin. Capillariasis caused by *Capillaria philippinensis* results in gastroenteritis and this is due to eating of raw small freshwater fish infested with the nematode. Similarly, consumption of raw, inadequately cooked or partially processed fish such as catfish, eels, carp and snakeheads is the main reason for gnathostomaisis caused by *Gnathostoma spinigerum*. Many aquacultured fishes harbour *G.spinigerum*.

Anisakiasis in humans is caused by *Anisakis simplex* due to the consumption of infected raw marine fish and cephalopods. In Japan about 3,000 cases of anisakiasis are reported annually. Many countries now insist that fish used for mildly processed products be frozen before processing or sale, although cooking and freezing may not protect against allergic reactions to ingested *A.simplex* antigens. Diphyllobothriasis is the most major human cestodiasis, which is caused by the consumption of marine or freshwater fish infected with the tapeworm *Diphyllobothrium latum*, found mainly in cold waters. Salmon has been recognized as an important carrier of the parasite. Other parasites such as *Taxoplasma, Trichinella*, which are more prevalent in red meat, are not usually encountered in fishery items.

Bacterial Pathogens

The human pathogenic bacteria which may be present in aquacultured finfish and crustaceans include *Enterdbacteriaceae, Vibrio* spp., *Aeromonas and Plesiomonas* spp., *Clostridium botulinum*, and *Listeria monocytogenes*. Significant numbers of organisms belonging to Enterobacteriaceae have been found in products harvested form waste-fed systems, and such products therefore pose a potential health risk. *Salmonella* spp. are among the most important causes of human gastrointestinal disease worldwide and many seafood-importing countries do not permit the presense of the organism in imported consignments. The organisms have been reported in fish ponds, which are usually scavenged by birds. *Salmonella* spp. have also been detected in the gut of aquacultured tilapia and carp. Where animal manure, particularly bovine manure, is used as pond fertilizer, there is a risk that pathogenic bacteria, including *Shigella* spp., have also been isolated in aquacultured systems. Poultry guts invariably harbour *Campylobacter* spp. and hence use of poultry-based manure may pose hazards in inland and coastal aquacultured fish. Nevertheless, the risk associated with consumption of

aquacultured fish infested with this bacterium is rather low.

Vibrio spp. being salt tolerant, occur in marine and brackishwaters, while *V.cholerae* and *V.mimicus* also occur in freshwater. Some *Vibrio* spp. are both human and fish pathogens. While cholera has been associated with the consumption of raw fishery products, there are no reported cases resulting from the consumption of commercially imported farmed finfish and curstaceans. *V.parahaemolyticus* has been a major cause of gastroenteritis and is particularly associated with the consumption of raw marine crustaceans and fish. *Aeromonas hydrophila* is associated with food-borne disease and *Plesiomonas* spp. has been implicated in outbreaks of gastroenteritis from fish consumption. *Clostridium botulinum* type E is naturally found in aquatic environments and is often isolated from fish. Another pathogen, *Listeria monocytogenes* is frequently reported from aquaculture products from temperate regions, but is rarely reported in tropical fishery products.

Other Hazards

White spot disease caused by viral contamination has been a major reason for the setback in shrimp aquaculture for the last few years. The disease is spread mostly through infected post-larvae of shrimps. Consumption of raw molluscan bivalves is a major cause of viral disease associated with aquatic animals. A large number of toxic compounds produced by aquatic algae and detrital bacteria, which serve as food for the larvae of commercially important crustaceans and finfish, have been reported to cause significant human health risks. However, it has been concluded that there is a very small risk to human health associated with these toxins in farmed finfish and crustaceans.

Sources of biological hazards

Water is the most critical one that is responsible for hazards. The use of waste water for fish farming or the practice of fertilizing ponds with animal manure may result in transmission of pathogenic bacteria and parasites to fish. Aquatic birds are known to harbour pathogenic strains of *V.cholerae* and *Salmonella* spp. which can infect the fish farms. The elimination of parasites or their intermediate snail hosts from water intended for public distribution in areas endemic for trematodiasis is difficult. In spite of recent practices such as putting crab fence and bird nets in the farms, it is impossible to control contamination by pathogenic bacteria in all aquaculture systems. Another important source of infection is feeds. The poor hygienic quality of fish meal used for aquafeed production may be source of contamination of organisms such as *Salmonella* spp., *coliforms*, osmophilic moulds and fungi.

Application of Low Dose Gamma Irradiation for Control of Biohazards

The global demand for safe and wholesome fishery products has attracted application of precautionary measures in fish production and processing which include Good Manufacturing Practices and Hazard Analysis at Critical Control Points. However, these efforts cannot fully eliminate many of the biohazards in fishery products. Exposure of foods to low doses of ionizing radiations from radioisotopes of cobalt or caesium or electron beam radiations has several advantages in this respect as compared with conventional techniques. It is a cold process, less energy consuming and does not leave any residue in the treated products. The salient features of food irradiation technology are summarised in Table 1. The benefits of irradiation of muscle foods including seafoods include reduction of spoilage-causing micro organisms for extension of refrigerated shelf life (radiation dose, 1 to 3 kiloGray (k Gy), destruction of pathogenic micro organisms in frozen fish and shellfish (4 to 6 k Gy) and elimination of parasites (1 k Gy). In 1980, the Joint Expert Committee under the aegis of Food and Agricultural Organization, International Atomic Energy Agency and World Health Organization concluded that any food irradiated up to a maximum dose of 10 kGy is safe for human consumption. (kGy is the unit of absorbed radiation; one kGy is equal to 1000 Gray, (Gy), and one Gy is equivalent to absorption of 10000 ergs of energy per g). In 1997, the Expert Committee has observed that in case a higher treatment dose is required for certain desired effect, it could be applied provided the food item can withstand the dose. Several professional bodies in the USA such as the American Medical Association, American Meat Institute, American Frozen Food Institute etc. have endorsed the safety of radiation processed foods. The food irradiation technology has been

Table 1. Salient features of radiation processing of fishery products

- Radiation treatment is low energy process.
- The treatment is a cold process since no rise in temperature of the product occurs.
- Cost effective process. The radiation sources, namely cobalt-60, caesium-137 and electron beams are available.
- Irradiation causes fewer overall physical and sensory changes than cooking, freezing or canning.
- Irradiation is a physical process and hence no external residues in the treated foods.
- High penetration power of the radiation can eliminate non-spore forming pathogenic bacteria and parasites even from the interior parts of fish.
- Ready-to-export frozen blocks of seafoods can be treated prior to shipment.
- Radiation pasteurization of chilled fish and shellfish helps in significant extension of shelf life by inactivation of spoilage-causing microorganisms.
- Accepted by several international bodies such as WHO,FAO,Codex Alimentarius Commission, US FDA etc.

approved by 42 countries worldwide for treating over 100 food items and some are applying this at least on a limited commercial scale. The frequently asked questions on radiation processing of foods and answers to these questions are summarised in Table 2. Table 3 provides answers to public concerns on application of the technology to seafoods. Global experience has shown that most of these concerns are due to ignorance of the consumers on the new technology and proper education can remove the fear.

Low dose of radiation can have significant uses in aquaculture. The treatment effectively eliminates the infectivity of several fish borne parasites. For most of the parasites, the Minimal Effective Dose (MED) for their elimination is in the range of 0.1 to 1.0 kGy (Table 4). It may be noted that the irradiation dose of 1 to 3 kGy required for shelf life extention of freshfish, as mentioned above, can also effectively eliminate infectivity of the parasites.

Gram negative bacteria, including pathogens such as *Salmonella* spp. are very sensitive to radiation. The D_{10} values, i.e., the radiation dose required for 90% elimination of the organisms, generally are in the range of 0.4 to 0.8 kGy. The D_{10} value is influenced by the type of organism as well as treatment conditions. Irradiation in the presence of fish components may slightly enhance the resistance. Table 5 gives the D_{10} values of several pathogenic microorganisms determined in fish/shellfish media under different conditions. Irradiation of aquacultured fish at doses ranging from 1 to 3 kGy can significantly reduce the biohazards. Crustaceans such as oysters filter water and therefore harbour large proportions of pathogenic microorganisms including viruses. In comparison to bacteria, viruses require higher radiation doses for inactivation.

Table 2. Frequently asked questions on Radiation Processing of Food

Q1. Does radiation processing makes food radioactive?

A. No. The radiation processing involves passing food through a radiation field but the food itself never comes in contact with the radioactive substance. Gamma rays, X-rays and electrons used do not induce any radioactivity in foods.

Q2. Is radiation-processed food safe for consumption?

A. Yes. Extensive scientific studies have shown that radiation processed food is safe for human consumption. Long term feeding studies with various animals as well as detailed investigation on the chemical changes have shown that there are no toxicological hazards to humans.

Q3. Does radiation processing affect the nutritional value of food?

A. No. In comparison to other food processing and preservation methods the nutritional value is least affected by radiation processing. The treatment has very little effect on the main nutrients such as proteins, carbohydrates, fats and minerals. Vitamins show varied sensitivity to food processing methods including radiation. For example, vitamin C and B_1 (Thiamine) are equally sensitive to radiation as well as heat processing. Vitamin A,E,C,K and B_1 in food are relatively sensitive to radiation, while riboflavin, niacin and vitamin D are much more stable. The Joint Expert Committee of the Food and Agriculture Organization (FAO), World Health Organization (WHO) and International Atomic Energy Agency (IAEA), in 1980 concluded that radiation processing does not induce any special nutritional problems in food.

Q4. What are the chemical changes in radiation processed foods and are they harmful?

A. Radiation processing produces very little chemical changes in food. None of the changes known to occur have been found to be harmful. The radiolytic products and free radicals produced are identical to those present in foods subject to treatment such as cooking, canning etc. Highly sensitive scientific tests carried out during the past 35 years have failed to detect any new chemical product in radiation processed foods.

Q5. How can radiation processed foods be identified in the market?

A. Radiation processed food cannot be recognized by sight,smell, taste or touch. Codex Alimentarius Commission has endorsed a green irradiation logo. As per the PFA (Fifth Amendment) Rules, 1994, all packages of radiation processed foods to be marketed in India will be labelled with this logo, along with the words "Processed by irradiation method", and the date of irradiation, license number of the facility and the purpose of irradiation. Consumers will have a free choice to buy radiation processed or non-radiation processed commodity.

International Status of Seafood Irradiation

As on December 2000, about 20 countries have accorded unconditional clearance for irradiation of various fishery products, including fresh, frozen or dried fish and shellfish products for shelf life extension, microbial, parasite and/or insect control. In the U.S., irradiation of seafood is under the consideration of the Food and Drug Administration. The International Consultative Group on Food Irradiation(ICGFI), established under the aegis of FAO,IAEA and WHO in 1984 helps to evaluate global developments in the field of food irradiation and provides guidelines on specific applications. The Codex Alimentarius Commission has adopted a General Standard for Irradiated Foods. The application of irradiation to individual food products including fish is covered in Special Code of Good Irradiation Practice elaborated by the ICGFI. The quality control system of the plant should be based essentially on the HACCP concept. According to Sanitary and Phytosanitary Measures (SPS), members of the World Trade Organisation (WHO), have the right to take legitimate measures to protect the life and health of their populations

Table 3. Public concerns regarding safety of radiation processed seafoods

Q1. Can radiation processing be used to make spoiled fish good, or to clean up "Dirty Fish"?

A. No. Like any other food treatment irradiation cannot reverse the spoilage process and make bad fish good. A fish that looks, smells and tastes bad cannot be saved by any treatment including radiation processing.

Q2. Can radiation processing be used to destroy microbial toxins and pathogenic viruses in fish?

A. No. As in many other food processing procedures only food of good hygienic quality should be irradiated. It is very important that foods intended for processing are of good quality and handled and prepared according to good manufacturing practices(GMP) established by national and international standards.

Q3. If *Staphylococcus aureus* has grown in fish producing enterotoxin, can the fish be treated with radiation and sold?

A. No. If *S.aureus* has already grown in fish and produced toxin due to mishandling, the fish will be spoiled due to the growth of spoilage organisms. Such spoiled fish cannot be treated with radiation. Further radiation processing does not destroy preformed toxin; in fact, the food needs to be treated allowing growth of bacteria.

Q4. How radiation processing is controlled to ensure that foods are properly treated?

A. The construction and operation of a food irradiation facility for commercial purpose is governed by the Prevention of Food Adulteration Act, 1954 and Rules, 1955 and the Atomic Energy (Control of Irradiation of Food) Rules 1996, under the Atomic Energy Act, 1962. Each food item and the dose needed to treat it for a specific purpose is cleared by the Central Committee for Food Standards(CCFS) and the food items approved for radiation processing are notified in the Gazette of India as an amendment of PFA. Operators are specially trained for the Food Irradiation Facility and Quality Control Officer ensures that only good quality foods manufactured using GMP are treated with the recommended dose. The processed food is labelled and all the records regarding dosimetry and radiation processing are maintained.

Table 4 Parasites associated with fishery products and radiation doses required for elimination of some parasites

Parasite class, And disease	Causative parasite sp.	Method of transmission	Host fish/shellfish	Radiation Dose•
Trematodiases Clonorchiasis	*Clonorchis sinensis*	Snail is the intermediate host	More than 80 species of freshwater	0.15
Opisthochiasis	*O.viverrini* & *O.felineus*	The free swimming	fish including farmed	0.10
Paragonimiasis	*P.westermani*	Cercariae from snail are released	Cyprinids	0.10
Heterophyiases	*H.heterophyes*, *H.nocens*, *H.continua*	which penetrate and reside	Brackish waterfish	
Metagonimus	*Puntius genionotus* *Metagonimus yokogaqwai*	in fish muscle		
Cestodiases Diphyllobothriasis	*Diphyllobothrium latum*,(tape worm) *D.yondgoense* *D.pacificum*	Human and mammals and other are definite hosts	Freshwater fish, intermediate host	NA
Nematodiases Capillariasis Gnathostomiasis Anisakiasis	*C.philippinensis* *G.spinigerum* *A.simple* *P.decipens*	Marine mammals, birds and pigs	Marine, brackish water or freshwater fish	7.0 2-10

• Minimal Effective Dose(MED) (kGy) required to eliminate ineffectivity. MED was determined using bioassays involving rats, hamsters, mice or cat. **NA** : Information not available.

Table 5: D10 Values of Some Pathogens in Fish/Shellfish Medium

Pathogen	Medium	Temperature(°C)	Atmosphere	D10(kGy)
Staphylococcus aureus	Surface of prawns	-10+2	Air	0.29
Vibrio cholerae	Surface of prawns	-10+2	Air	0.11
V.flacvialis	shrimp paste	-20	Vacuum	0.44
V.mimucus	Shrimp paste	-20	Vacuum	0.75
V.parahaemolyliticus	Shrimp paste, 1% NaCl	-20	Vacuum/air	0.44/0.07
V.parahaemoliticus	Fish homogenate	Ambient	Air	0.03/0.06
V.vulnificus	Shrimp paste, 1% NaCl	-20	Vaccum/air	0.30/0.35
V.alginolyticus	Shrimp paste	-20	Vaccum	0.19
Aeromonas hydrophila	Bombay duck homogenate	0	Air	0.14
A.hydrophila	Shrimp homogenate	0	Air	0.10
Shigella flexneri	shrimp homogenate	Frozen	-	0.22
Salmonella paratyphi A	Oyster homogenate	5	-	0.75
S.paratyphi B	Oyster homogenate	5	-	0.85
S.typhimurium	Shrimp,mackerel, or golden anchovy homogenate	0-2	Air	0.10-0.15
S.typhi	Crab meat	-	-	0.87
Steptococcus fecalis	Shrimp homogenate	-	-	5-7.5
Bacillus cereus	Shrimp, mackerel, or golden anchovy homogenate	0-2	Air	0.2/0.3
Listeria monocytogenes	Shrimp, mackerel, or golden anchovy homogenate	0-2	Air	0.15-0.25
Yersinia enterocoliticus	Shrimp, mackerel, or golden anchovy homogenate	0-2	Air	0.10-0.15
Hepatitis A virus	Clams and oysters	Not stated	Air	2.02

from hazards in food. Irradiation of aquacultured fish can immensely enhance its hygienic quality and protect the consumer, especially when these fish items are consumed as raw, minimally cooked or picked, as mentioned above, the radiation Treatment plants may be of mobile type or centrally located near the ponds. The treatment therefore can ultimately result in an increased consumer Irradiaconfidence in the products and hence enhanced international trade.

Literature cited

1. Food safety issues associated with products from aquaculture. Report of a Joint FAO/NACA/WHO Study Group, WHO Technical Report Series 883, W orld Health Organization, Geneva, 1999.

2. Irradiation of fish, shellfish and frog legs. A compilation of technical data for authorization and control. International Consultative Group on Food Irradiation established under the aegis of FAO, IAEA and WHO, International Atomic Energy Agency, Vienna, June 2000.

3. Radiation processing to improve the quality of fishery products. V. Venugopal, S.N.Doke and P.Thomas. Critical Reviews and Food Science and Nutrition, **39**, 341-440,1999.

Chimes Essay Competition Planned

Fishing Chimes is planned to hold an Essay Competition among B.F.Sc students on a fisheries topic of prime interest, at various convenient centres. In this context, *Fishing Chimes*, invites suggestions in finalising details, addressed to Editor, *Fishing Chimes*.

EU : New Labelling Regulation

The European union has adopted the Commission's proposal on labelling of seafood w.e.f. 1st January 2002. The objective of the regulation is to inform the customers about the production method the catch area and the denomination (commercial name).

The new regulation applies to domestically produced and imported seafood products with catch areas as those established by FAO.

Diverse Fishery Resources in the Seas around Andaman & Nicobar Islands

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The Union Territory of Andaman and Nicobar Islands in the Bay of Bengal lying between 6°45' N and 13°41' N latitude and 92°12' E and 93°57' E longitude consists of about 550 islands, islets and rocky outcrops and enjoy the status of archipelago. It has a coastline of 1962 km, which is about one fourth of the total coastline of India. Within a few kilometres from the seashore, the sea is very deep thus limiting the continental shelf area to about 4,52,000 sq. km. However, with the declaration of 200 miles Exclusive Economic Zone (EEZ) the Andaman and Nicobar Islands encompass about 0.6 million sq. km, which is about 30% of EEZ of India. This provides a great opportunity to exploit the vast resources of the seas around these islands to our advantage.

Potential

Jones and Banerjee (1972) estimate a potential of 4,000 tonnes of demersal fish and 8,000 tonnes of pelagic fish in the waters around these islands. Kumaran (1973) estimated a potential of 50,000 tonnes in the area of 3,00,000 sq. miles. Cushing (1971) has estimated 0.20 million tonnes during Northeast monsoon and 0.27 million tonnes during Southwest monsoon in the upwelling area of east Andaman seas. The earlier estimates for coastal fisheries of A & N Islands were around 12,000 tonnes; 8,000 being pelagic and 4000 tonnes being demersal. The Working Group for revalidation of fishery potential has accepted the estimate made by Fishery Survey of India in 1990; according to this estimate the pelagic resource potential (0-200m) is 130,000 tonnes and demersal resource potential (0-50m Zone) is 22,500 tonnes. Oceanic tuna potential is 82,000 tonnes. Thus the extensive survey by F.S.I. indicated a total potential of 2.345 lakhs tones (Table-1).

There is no organized offshore fishing from Andaman base. However, the Fishery Survey of India is conducting systematic exploratory fishing since October, 1971. Bottom trawling, long lining, trolling, kalava lining and purse seining has been conducted. Catch rates of as much as 100 kg per hour obtained in Andaman waters is comparable to those obtained in the east coast of India. The demersal fishes obtained by trawling are Leiognathids (33%), Upenids (19%), Sciaenids (12%),

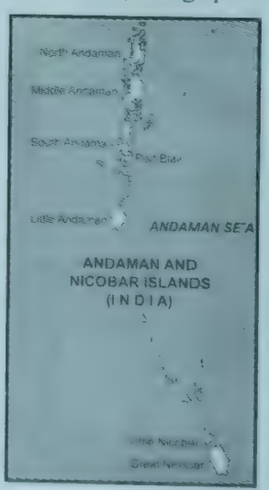
Table 1 : Estimated Fishery resource potential for Andaman and Nicobar Islands

S.No	*Author*	*Category of Fish*	*Potential (in tonnes)*	*Remarks*
1.	Jones and Banerji (1973)	Demersal and Pelagic	4,000 8,000	Based on catch rate and composition
2.	Cushing (1971)		2,00,000 2,70,000	North east monsoon South east monsoon in the upwelling area of east Andamans
3.	Kumaran (1973)	Demersal and Pelagic	50,000	Based on organic production
4.	Sudarsan (1978) (for continental shelf area)	Demersal	45,000	Based on swept area method
5.	Fisheries Expert Team (as cited by Sivaprakasam 1979)	Tuna Demersal Pelagic	1,00,000 20,000 40,000	-
6.	Bhakta (1983) (for EEZ)	Demersal and Pelagic	8,21,108	-
7.	Fishery Survey of India report	Pelagic resource Demersal resource Oceanic tuna	1,30,000 22,500 82,000	-

Skates (5%), Rays (3.5%), Sharks (3%), Nemipterids (3.5%), Carangids (2.5%), Catfish (2%), Perches (1%), Lizard fishes (0.8%) and other miscellaneous fishes (Sivaprakasam 1979). Sudarsan (1978) stated that good catches of sharks and marlins were met with in long lining areas south of North 'Andaman and east of Little Andaman including the invisible banks. Trolling lines were tried while proceeding to the fishing ground and returning to the port. During survey schools of sardine, mackerel, skipjack and other varieties of tuna were also encountered in the invisible banks which are also located about 60 miles South of Port Blair and North East of Little Andaman. The period between October and March is more productive than other periods. In the trolling operations conducted during 1973-76, catch rates up to 56 kg/hr could be obtained. Carangids (28%), Tuna (17%) and Perches (4%) were the important fish groups caught by trolling. (Sudarsan 1978), Kalava lines operated during 1974-75 could obtain highest catch of 18 kg/hr. Perches (23%) Shark (15%), Carangids (6%) and Tunas (3%) were the important fish groups caught. Purse seining was not highly successful. Even though fish schools could be sighted they were not large enough. Further, the size of the vessel and the net was not adequate for operating in deep waters (Sudarsan 1978). Fishery Survey of India has been conducting trials of tuna longlining for sometime past and the chartered vessels have also operated tuna longline in the past few years, yielding some useful information on the species composition and the area of abundance.

There are a few important landing centers (Diglipur, Mayabunder and Rangat) in the North and Middle Andaman and five other landing centres (South Andaman, Little Andaman, Car Nicobar, Non cowry, and Campbell Bay) Table –2.

With respect to vast exploitable fishing resources, around various islands, fishing is yet to be developed. The infrastructure facilities for storage and marketing are in a developing stage. Only in Port Blair and in Hutbay, a cold storage and iceplant are operational now. One cold storage and ice plant at Campbell Bay may soon become operational. Administration has its plan to have cold storage and ice plant facility in major landing centres such as Rangat and Mayabunder (Middle Andaman), Diglipur (North Andaman) and in Havelock island in order to establish a cold chain.



At present the fishing effort is confined to coastal areas. Crafts smaller than 12 metres length, fish in 12 to 14 fathoms depth. Fishing is mainly carried out by traditional crafts, dinghies, motorised and mechanical boats. In three major islands fishing could be carried out throughout the year excepting during June and when the sea is turbulent. The best fishing season is the pre-South West Monsoon period covering the period January to April. For perches the peak season is August to November.

The types of gears used are gillnets (about 1,000), hook and lines (900), Castnets (600), shore seines (50) and anchornets (40), disco nets etc. Gearwise fish landings in Andaman and Nicobar Islands are given in table-3.

The fish-landing chart (Fig.1 &2) indicates that there is no single group dominating the fish landings. The landing trend also indicates that the potential harvestable stocks of all commercially important varieties of fishes would be many times more than the present landings, it will not be wrong to assume that when the policy of fishing will encourage more organized fishing, the fish landing will also go up substantially and infrastructure now available may not be able to cope up with respect to the growth of fishing industry.

Table-2 Region wise fish landing (in tonnes) in Andaman and Nicobar Islands

Name of the region distance from Port Blair	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*
Diglipur 185 km	842	1,251	1,241	1,662	1,306	1,478	1,954	1,100
Mayabunder 157 km	624	953	982	1,166	784	797	898	816
Rangat 93km	2,650	2,715	1,985	2,360	2,090	2,128	3,558	2,727
South Andaman	16,396	17,993	16,931	18,874	19,560	19,744	16,872	22,755
Little Andaman	585	895	760	902	1,045	1,013	800	836
Car Nicobar	177	224	210	277	261	222	121	93
Nancowry	515	620	582	692	552	650	319	135
Campbell Bay	550	753	643	762	522	519	452	461
Total	22,339	25,404	23,334	26,695	26,120	24,974	24,974	28,983

Fishery Status

Andaman and Nicobar islands with Exclusive Economic Zone 0.6 m sq km offer excellent base for developing marine fisheries. More than 1,100 fish species, majority of which are commercially important, occur in Andaman waters

Table-3 Gear wise fish landing (in tonnes) of Andaman and Nicobar Islands during the year 1991-98

S.No.	Name of the Gear	1991	1992	1993	1994	1995	1996	1997	1998
1.	Cast net	2,234	2,594	2,567	3,203	3,134	3,215	3,125	3,963
2.	Shore seine	3,798	4,214	4,312	4,805	4,702	4,795	4,339	4,935
3.	Gill net	9,382	10,709	9,800	11,218	10,970	11,045	10,296	12,557
4.	Hook and Line	3,351	3,603	3,267	3,731	3,657	3,745	3,641	3,435
5.	Trolling Line	27	31	28	32	52	50	48	38
6.	Anchor or stick net	2,010	2,468	2,100	2,403	2,351	2,451	2,325	2,508
7.	Traditional methods	1,537	1,785	1,260	1,303	1,254	1,250	1,200	1,451
8.	Disco net	-	-	-	-	-	-	-	96
9.	Bow and arrow	-	-	-	-	-	-	-	10
	Total	22,339	25,404	23,334	26,695	26,120	26,551	24,974	28,963

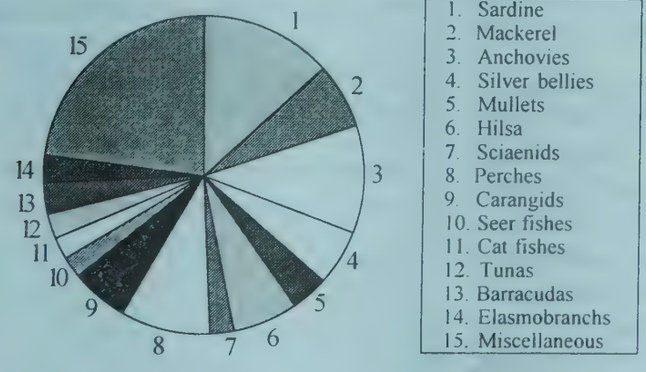
(Dorairaj *et al* 1994). The trend of fish production in the last four decades is depited in Fig.3. The analysis of the catch data for 1995-98 showed that Anchovies 10.59%, Sardine 12.69%, Mackerel 5.26%, Silver bellies 5.01%, Perches 6.91, Pomfret 1.45%, Hilsa 6.31%, Mullets 3.61%, Barracudas 3.49%, Seerfishes 2.92%, Catfishes 2.01%, Carangids 5.19%, Crustaceans (Prawn, Crab etc.) 2.32%, Ribbon fishes 1.81%, Elasmobranchs 3.66%, Tunas 6.12% and miscellaneous 20.65%.

A consistent increase year after year in the annual fish catch from 15,327 tonnes (1990) to 28,963 tonnes (1998) is noticed. Even though, EEZ of Andaman and Nicobar Islands is nearly 30% of India's EEZ, the total marine production is nearly about 1% of that of India (Compared with 1998 total fish landing of mainland India).

The Sardines, Anchovies and Hilsa are caught by gillnets, boat seines and shore seines. The important genera are *Sardinella, Dussumieria, Pellona, Herkilotisicthys* and *Anadantostoma. Herkilotisicthys punctatus* contributed nearly 70% of the total sardine catch. The main season of fishing is from July to December (Dorairaj and Soundrarajan 1985).

Among the anchovies *Thryssa* and *Stolephorous* contributed to the major catch. The main season of fishing is from July to December. Two species of mackerels namely *Rastrelliger kanagurta* and *Rastrelliger brachysoma* contributed to the fishery, the main gears used are gillnets and boat seines and good fishing season are March-June and September December. The perches are mostly caught by hook and line and gill net. The important species belonging to genera *Lethrinus, Lates, Lutjanus, Pomadasys, Epinephelus* etc. The main fishing season is from August to November. The carangids landed by gillnets and boat seines and the major

Fig 1 PERCENTAGE COMPOSITION OF FISH LANDING IN ANDAMAN AND NICOBAR ISLANDS (1990-94)



PERCENTAGE COMPOSITION OF FISH LANDING IN ANDAMAN AND NICOBAR ISLANDS (1995-98)

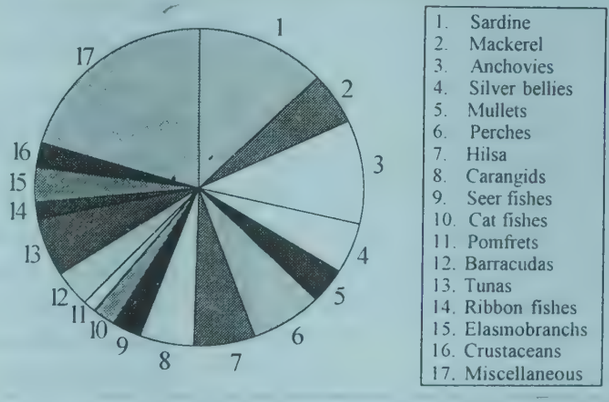
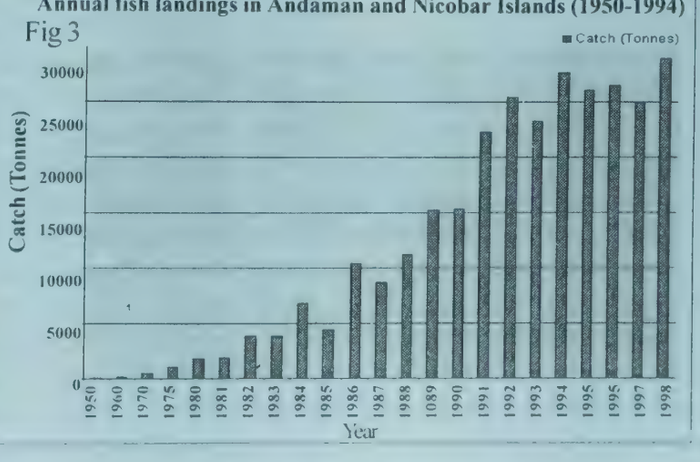


Fig 3 Annual fish landings in Andaman and Nicobar Islands (1950-1994)



genera caught are *Caranx*, *Selar*, *Chorinemus*, *Elegatus* and *Decapterus*. The favourable fishing season is from July to November. Silver bellies are mostly caught in boat seine and shore seine and are represented two genera namely *Leiognathus* and *Gazza*, former accounting for more than 90%. The main season is from June to December. The mullets and barracudas are caught by gillnet and boat seine and the peak season is from July to December. The main species of mullet that are caught are *Mugil cephalus* and *Liza tade*. The latter migrates along the tides into the creeks for foraging. The tuna and seer fish are mainly caught in gillnet and hook and line during March-August. The peak season of fishing coincides with the premonsoon period. During South west monsoon the fishery is at its lower ebb. The important tunas forming a fishery are (*Euthynnus affinis*) and Skipjack tuna (*Katsuwonus pelamis*), the former being the dominant in the gillnet catches. Among the various categories of fish available in these waters, the tuna and tuna-like fishes are the most important ones. They are significantly abundant around Great Nicobar, South of Car Nicobar and Southern regions. The best fishing grounds lie upto 5° on either side of the equator. In the Nicobar Zone the Yellowfin tuna, Big eye tuna, Skipjack, Northern Blue fin tuna, Little tunny, Marlin and Indian sail fish etc. are available. A stock of 25,000 tonnes of yellow fin and Bigeye and 50,000 tonnes of skipjack are estimated for Andaman and Nicobar region. Skipjack is essentially a surface fish and prefers waters where salinity is 33% or more and the optimum temperature for skipjack in waters in the Indian Ocean appears to be 28°C.

Among the seerfish *Scomberomorus guttatus* and *Scomberomorus commerson* land in good quantities. The elasmobranchs are mainly caught by gillnet and longline and sharks are mainly caught for their fins for export. The species mainly belong to *Carcharhinus*, *Scoliodon* and *Sphyrna*. There have been sporodic catches of deep-sea sharks. *Centrophorus acus* and *Squalus* sp. for liver extraction. Sciaenids and catfish are come across in trawl catches.

Among crustaceans, shrimps are mainly caught in bagnet, boatseine, dragnet and castnet, mostly relying on tidal cycles and lunar periods. About 19 species of shrimps occur of which *Penaeus merguiensis* (49%) and *Metapenaeus dobsoni* (42%) are dominant with *Penaeus monodon, P. Semisulcatus* and *M. ensis* being caught in stray numbers in bottom set gillnets, operated mainly for fishes. Six species of lobster occur namely *Panulirus versicolor*, *P. ornatus*, *P. pencillatus*, *P. longiceps*, *P. homarus* and *P.polyphagus*.

Three species of Portunid crabs namely *Scylla serrata, Portunus pelagicus* and *Portunus sanguinolentus* are caught by bottom set gillnets. *Scylla serrata* is also being caught in marshy areas by placing hooks on crab holes.

Among the molluscs, the gastropod, namely *Trochus* (topshell) and *Turbo* (turban shell) are exploited heavily and the fishery is known as early as 1929. Nine fishing zones have been demarcated by the local Government for the exploitation of these shells, with regulation in respect of size of shell to be fished, and also the imposition of closed season in every alternative couple of years.

The average annual landing of *Trochus* has decreased from 500 tonnes in the early eighties (Nayar and Appukuttan 1984) to less than 100 tonnes in recent years. *Turbo* has been overfished and has become rare at present. These shells have ornamental value as raw material for shell craft industry. The other gastropods collected extensively are sacred chank *Xancus* sp. helmet shell (*Cassis corrunata*), five finger chanks (*Lambis* spp.) cone shell (*Conus* spp) and Cowries (*Cyprea* spp). Pearly nautilus, *Nautilus* sp. is an important cephalopod, the shell of which is used in preparation of lampshades and other curios. The edible oyster *Crassastrea madrasensis, Sarcostrea cuculata*, green mussels (*Perna viridis*), pearl oyster (*Pinctada margaritifera, Pteria pengium* and giant clams (*Tridacna maxima, T. squamosa* and *T. crocea*). The sea cucumber *Holothuria atra, Holuthuria scarba, Actinopyga maurituna* and *Sctinopyga miliaries* which are useful in producing *beche-de-mer*, an exportable commodity, occurs in abundance in many mud reef flats (James, 1983). Similarly, the edible sea urchin, *Tripneutes gratilla* is quite common in algal beds in intertidal regions. It gonads are massive and considered to be a delicacy. There is a good potential to farm sea cucumbers by collecting young ones and rearing them in enclosed areas in the intertidal regions.

There are plenty of reef fishes, which are commercially important as ornamental fishes, but ornamental fish trade is non-existent in Andamans, local government has banned their capture as a protective measure for coral reefs.

About 55 species of seaweeds occur in these islands (Gopinathan and Panigrahy 1983). Among alginophytes namely *Turbinaria sargassum* and *Padina* are dominant. The availability of abundant seed materials, especially in Andaman group of Islands, offer good scope for culturing alginophytes in the lagoons of John Lawrence island, Carbyn's cove, Navy bay region of Port Blair and Chidiatapu with sandy substratum. Suitable sites are also found in the Nicobar group of Islands, namely Sawai Bay of Car Nicobar, East Bay of Katchal and spiteful Bay of Nancowry.

Area and Scope for Coastal Aquaculture

Coastal aquaculture in Andamans is in a preliminary stage. One experimental farm in brackishwater aquaculture has been set up in Sippighat, South Andaman by Central Agricultural Research Institute during 1983. Experiments have been carried out for culture of mullet, prawn, seabass, tilapia as well as mudcrab during the last decade and a half. Marine Product Export Development Agency along with Department of Ocean Development and in collaboration with the Andaman and Nicobar Administration did set up a farm at Minnie Bay for shrimp cultivation. There was a moderate success, with a production about 1-2 tonnes/ha. National Institute of Ocean Technology is now carrying out some experiments in mariculture in the

islands.

Apart from this, there is some unorganized freshwater fish culture in small irrigation ponds. Through the efforts of Central Agricultural Research Institute, Port Blair and Department of fisheries, Andaman Administration, a marked increase in freshwater fish yield has been achieved. Currently, the island has become self sufficient in major carp fish seed production.

The water bodies in the tidal creeks and inlets with the adjoining pond area offer scope for the development of shrimp/fish farms. The shallow protected bays are considered to be suitable for raft culture and cage culture. In the open high sea conditions there is scope for setting up floating cages for fish culture and long lines for sedentary molluscs. Through these methods fish production can be increased several folds.

It is desirable that brackishwater aquaculture should be taken up only in such of the areas where land has already been affected by salinity intrusion and in barren mangrove areas devoid of much vegetation and unutilised fallow lands which are not fit for any agricultural purpose (Dam Roy *et al* 1996).

Mullet Culture: *Liza tade* is the dominant species found in the brackishwater area. These have been cultured on experimental basis in brackishwater ponds in varying stocking densities such as 6000/ha, 7500/ha, 10,000/ha, 12,000/ha, 15,000/ha and 30,000/ha. The crop duration ranged from 3 to 8 months. Production per hectare ranged from 111 to 342 kg, with an average production of 232 kg/ha. The average percentage of survival is 70%. Although a low production is obtained the important fact is that the culture is sustainable.

Seabass culture: There is a good prospect of seabass (*Lates calcarifer*) culture in brackishwater ponds as well as in cages. The size of the stockable seed available ranges from 200-300 mm. Experimental culture indicated that the average monthly growth rate is 14.5 mm (25g). Tilapia and shrimp (*Metapenaeus* sp.) were used as forage feed. The fish is observed to grow to a size of 0.8 to 1.0 kg within a period of one and half years. The production at 60% survival and at a stocking density of 5000 no/ha has been estimated to be 2,975 kg/ha/yr. However, for assured seed supply one has to depend upon hatchery produced seed from mainland till such a facility is set up here.

Milkfish Culture: The milkfish *Chanos chanos* offers a good scope for culture in brackishwater areas in Andamans. Although adult milkfish forms a seasonal fishery, no locations of milk fish seed availability have been located in these islands. However, some stray locations of milkfish seed occurence have been located brackishwater ponds at Sipighat. Culture experiment have indicated that growth of milkfish under brackishwater condition is remarkable compared to mullets. In confined conditions they have grown to 1.25 to 1.5 kg within a period of 2 years. A production of 600 kg/ha. is obtained at 30 % survival within a period of 13 months (Dam Roy *et al.*,1996).

There is possibility of culture of mangrove red snapper and yellow fin travelly, *Caranx ignobolis* in brackishwater areas.

Culture of Tilapia: In a culture experiment conducted in a brackishwater pond, a production of 1,260 kg/ha/year was obtained. Recently, with a view to culture monosex tilapia, a culture experiment was conducted in a 0.05 ha brackishwater pond. A production of 1,036 kg/ha was obtained in six-month culture period.

Culture of Mud Crab: Amongst the cultivable shellfishes, mud crabs *Scylla serrata* is considered to be a delicacy and has a great demand. Two culture experiments were carried out at Sipighat brackishwater farm at stocking densities of 5,000/ha and 3,000/ha respectively. After 8 months of culture mud crab has attained an average weight ranging from 254 to 306 g. Some crabs have grown over 500 g also. Estimated production at a stocking density of 5,000 no/ha works out to 918 kg/ha/8 months.

Discussion

The annual marine fish production of Andaman and Nicobar Islands from 1980 to 1998 ranged from 1,803 tonnes to 28,963 tonnes. Although Andaman and Nicobar Islands have got 0.6 million sq km of Exclusive Economic Zone (which is about 30% of EEZ of India), the total marine production; as in 1998, is about 1% of that of India, despite the fact that, 1,151 species of fishes majority of which are commercially important, occur in Andaman waters. (Dorairaj *et.al* 1994).

As most of the fishermen who hail from mainland go for traditional fishing, using traditional boats fitted with in board engine, and using gears such as gill net, hook and line, bag net, shore seines and anchor net, most of the fishery, off the island's coast remains unexploited. Added to this, the transportation, preservation, storage and processing facilities are also poor, although it appears there are plans to provide adequate infrastructure for the post harvest preservation and storage requirement for the different islands of A&N Islands (Krishnamurthy, V. 1996). The present fish landings cater only to meet local needs. There is no incentive to bring more catches for want of processing facilities. Thus, there is a need for diversification of fishing effort, keeping in view of the varied fishing resources of A & N waters. What is required is diversification of fishing craft gears and tackle, upgradation of skills of fishermen as well as setting up basic facilities like ice plants, cold storages and processing facilities, transportation facility etc.

Andaman and Nicobar islands are bestowed with creeks and bays which are ideal for cage culture of groupers, seabass etc. Further, there are indications that culture of fishes like, mullets, seabass, milkfish and shellfishes like shrimps, mudcrabs in brackishwater ponds can increase fish production.

In Andaman and Nicobar Islands, fishery development is yet to assume importance as a major source of economic development. The oceanic waters around the islands offer excellent scope for the

exploitation development of oceanic fisheries especially of tunas. Some of the features like island topography, the temperature gradients with thermocline between 50 m and 100 m depth, the productivity consequent to mixing of water masses etc. indicate favourable habitat for migratory tunas, like skipjack and yellowfin. But oceanic fisheries development needs large capital investments, infrastructure facilities and above all trained manpower. But the islands lack a traditional fishing population and those fishermen now engaged in fishing are settlers mainland. A study conducted on the socio-economic conditions of fishermen of Andaman and Nicobar Islands revealed that the fishermen of Andamans are mainly migrants from Andhra Pradesh, followed by people of erstwhile East Bengal, West Bengal, Kerala and Tamil Nadu. This factor, coupled with the remoteness of the islands, inadequate infrastructure and non existence of fish trade with outside markets are the constraints impeding fast development of fisheries which depends on technology transfer, training of manpower, government support for capital investment on vessels and gears suitable for oceanic fishery exploitation.

References

BHAKTHA, N.P, 1983. Development of infrastructure facilities for the optimal exploitation of the exclusive economic zone. In Fisheries Development in India. Concept Publishing Company, New Delhi pp.313-326.

CUSHING, D.H., 1971. Production in the Indian ocean and the transfer from primary to secondary level. In the Biology of the Indian Ocean. Bernt. Zeitschel (Ed) S. Springer-Verlag, Berlin : 475-486.

DAM ROY, S., SOUNDRARAJAN, R and DORAIRAJ, K. 1996. Environmental issues and prospects of brackishwater aquaculture in the Andamans. In the proceedings of Island Ecosystem and Sustainable Development. National Seminar at Port Blair 8-9 Feb. 1996.

DAM ROY, S. and DORAIRAJ .K 1996. Socio-economic aspects of fishermen of Andaman with reference to sustainable development. In the proceedings of Island ecosystem and sustainable development in National Seminar at Port Blair 8-9 Feb. 1996.pp.

DORAIRAJ, K and SOUNDRARAJAN R (1985). Exploited Marine Fishery Resources of Andaman and Nicobar Islands in *J. Andaman Sci. Assoc.* **1** (1) : 49-58.

DORAIRAJ, K and SOUNDRARAJAN R 1987a. "Coastal environment and fishery resources of the Bay Islands". In the proceeding of the symposium on Management of coastal ecosystems and oceanic resources of the Andamans. 17-18 July, 1987 pp. 40-49.

DORAIRAJ, K and SOUNDRARAJAN R 1987 b "Coastal aquaculture : prospects and problems" on the proceedings of the symposium on Management of coastal ecosystems and ocean resources of the Andamans. 17-18 July, 1987 pp. 71-79.

DORAIRAJ, K., SOUNDRARAJAN, R and Jagdish, I. 1994. Checklist of fishes of Andaman and Nicobar Islands published by Cent. Agril. Res. Inst., Port Blair, Andamans.

GOPINATHAN, C.P. and PANIGRAHY M.S. 1983. Seaweed resources. *Bull.Cent.Mar.Fish.Res.Inst.* 34 : 47-51.

JAMES, D.B. 1983 Sea cucumber and Sea urchin resources and beche-de-mer industry. *Bull.Cent.Mar.Fish.Res.Inst.* 34 : 44-46.

JONES, S and BANERJEE S.K. 1972. A review of the living resources of the Central Indian Ocean. Proc. Symp. on living resources of the seas around India *Mar.Biol.Ass.India*, pp. 1-17.

KRISHNAMURTHY, V. 1996. Utilisation of marine resources of the Andaman and Nicobar Islands. In the proceedings of the sixth workshop of the tropical marine molluscs programme. Puket marine biological center special publication No.**16** (1996) : 331-333.

KUMARAN, M. 1973. The fishery potentials of Andaman and Nicobar Islands. Proc. symp. on living resources of this seas around India. *Mar.Biol.Ass. India*, pp. 387-389.

NAYAR, K.N. and APPUTUTTAN, K.K. 1983. Primary production in coastal waters. *Bull. Cent. Mar. Fish. Res. Inst.* No.**34** : 81-84.

SIVAPRAKASAM, T.E. 1979. The living resources of Andaman and Nicobar seas. *The Andaman and Nicobar information* 1975-76, Port Blair. pp. 173-175.

SUDARSAN, D. 1978. Results of exploratory survey around the islands. *Bull. Exp. Fish. Proj.* No. **7** : 1-43.

SOUNDARARAJAN, R. 1996. "Development of the tuna fishery in the exclusive economic zone of the Andaman and Nicobar Islands" (India) a dissertation submitted to the Department of Marine Sciences and Coastal Management, University of Newcastle upon Tyne.

Klensol

Aquacare Division of Tetragon Chemie Ltd., Bangalore, has been marketing "Klensol", which is stated to be a powerful disinfectant. The brand name "Klensol" is owned by Tetragon Chemie Ltd., Bangalore. It is stated that Klensol is very effective against a variety of Bacteria, Fungi and Protozoan species at low dosages and with minimal contact durations. It is used by processing plants where disinfection and residual odour are of prime concern.

The manufacturers say that Klensol is currently being used in aquafarms for water disinfection at dosages of 4-5 lt per acre. It is also mentioned that the product is gaining popularity among certain localised shrimp procurement/ pooling centres for disinfection and product cleaning, post harvest.

Further details can be obtained from : The Manager - Aquacare, Tetragon Chemie Pvt. Ltd., IS-40, KHB Industrial Area, Yelahanka New Town, Bangalore - 560 064

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MARKET TRENDS

(As in the week ending 03-01-2002)

Refreshingly, the gloom that enveloped prices of exported shrimp to Japan upto Oct. 2001 has given way to a rise in overseas offer prices. Black Tiger HL contracts were made at higher prices, apparently because of anticipated good year end and new year sales. The export rates that prevailed in the week ending 04-01-2002 are as follows.

So far as USA is concerned, demand for black tiger is stated to be continuing strong, transforming the recent picture of lows. Whites and browns are also stated to be edging upward.

Item	*Count range*	*Price range ($/Kg)*
JAPAN		
HL BLACK TIGER		
a) Kolkata	8/12 - 41/50	17.50 - 6.70
b) Bhubaneswar	8/12 - 21/25	18.40 - 10.20
c) Visakhapatnam	8/12 - 36/40	17.70 - 7.90
d) Chennai	11/15 - 31/35	16.30 - 7.60
HL SEA TIGER		
a) Visakhapatnam	U/5 - 16/20	20.30 - 9.40
SEA TIGER		
a) Bhubaneswar	U/5 - 31/50	20.35 - 4.45
b) Manglore	11/15 - 41/50	15.20 - 6.00
HL WHITE		
a) Manglore	11/15 - 51/60	11.50 - 4.00
b) Tuticorin	51/60 - 71/90	5.00 - 3.60
c) Visakhapatnam	8/12 - 61/70	17.10 - 2.30
d) Bhubaneswar	8/12 - 36/40	19.00 - 6.30
HL FLOWER		
a) Visakhapatnam	6/8 - 26/30	16.20 - 6.30
b) Tuticorin	8/12 - 41/50	16.80 - 4.00
c) Bhubaneswar	6/8 - 41/50	16.35 - 4.05
HL BROWN PINK		
a) Bhubaneswar	31/35 - 91/110	6.10 - 2.30
PUD		
a) Visakhapatnam	U/20 - Broken	8.70 - 1.80
b) Tuticorin	10/20 - Broken	8.40 - 1.60
c) Mangalore	80/120 - Broken	4.80 - 1.70
d) Mumbai	100/200 - 300/500	3.60 - 2.70
e) Kolkata	80/120 - 300/500	5.00 - 2.80
USA/CANDA		
PD (lb)		
PD Kochi	111/130 - 300/350	2.10 - 1.60
PUD (lb)		
Kolkata	80/120 - 400/500	4.30 - 2.00
Kochi	80/120 - 500/800	4.50 - 2.40
Visakhapatnam	71/90 - 151/200	2.33 - 1.48
PUD Tail on		
Kochi	81/110 - 500/800	2.27 - 1.63
HL BLACK TIGER(1bs)		
Bhubaneswar	13/15 - 41/50	6.85 - 7.30
Chennai	8/12 - 71/90	8.40 - 2.10
Tuticorin	13/15 - 41/50	7.30 - 3.00
Visakhapatnam	13/15 - 31/40	7.00 - 3.10
HL Scampi		
Quilon	6/8 - 26/30	5.25 - 2.50
Chennai	6/8 - 16/20	12.70 - 6.55
Cuttle fish		
Whole cleaned	U/1	1.30
Squid (lb)		
Whole	U/3 - 3/6	2.25 - 2.10
Whole cleaned	U/5-20/40	1.12 - 0.85
EUROPE		
PD Shrimp		
UK	Broken	1.40
PUD Shrimp		
UK	80/120 - Broken	4.20 - 1.80
Germany	10/20 - 0/80	8.40 - 5.00
PUD		
Deep sea Pullan	80/120 - 500/800	3.00 - 1.60
Deep sea shrimp	40/ 60 - 300/350	5.00 - 2.00
Blanched white shrimp	51/ 60	7.85
HL BLACK TIGER		
Bhubaneswar	31/40 - 51/60	7.85 - 5.85
HL PINK		
Visakhapatnam	21/25 - 91/110	8.40 - 2.90
CUTTLE FISH		
Whole Cleaned to		
a) Spain	1/2 - 20/40	2.70 - 1.45
b) France	U/1 - 1/2	2.90 - 2.70
c) Italy	U/1 - 2/4	2.40
SQUID		
Whole Cleaned to		
a)Italy	U/5 - 3/6	2.40 - 2.15
b)Portugal	100/200 - 100/150	1.62 - 1.30
Whole to		
a) Italy	U/3 - 6/10	2.15 - 1.78
b) Spain	U/3 - 100/Up	2.15 - 0.40
HONG-KONG, THAILAND, BANGKOK, TAIWAN, CHINA, MALAYSIA		
HL Scampi	6/8 - 26/30	11.70 - 4.50
HL BLACK TIGER		
China	51/60 - 91/100	5.80 - 3.00
Thailand	41/50 - 71/90	6.80 - 4.00
Bangkok	41/50 - 71/90	6.80 - 4.00
SQUID (Whole)		
Taiwan	U/10 - 20/40	2.05 - 1.60
Thailand	6/10 - 20/40	1.60 - 1.10
Malaysia	U/3 - 20/40	1.85 - 0.90
Whole Cleaned		
Taiwan	U/3 - 6/10	2.00 - 1.40
CUTTLE FISH (Whole)		
China	50/100 - 300/Up	0.80 - 1.90
FISH		
a) Silver Pomfret		
Taiwan	300/400 -1000/Up	4.40 - 10.00
Hong Kong	300/400 -500/600	3.90 - 5.50
b) Ribbon Fish		
China	100/200-400/Up	0.41 - 0.71
Hong Kong	100/200-700/Up	0.41 - 0.71
c) Malaysia		
White pomfret	300/Up	3.85 Black
Pomfret	300/40	1.65
Seer fish	500/1000 - 3000/Up	1.60 - 1.65
Mackerel	2/4-8/12	0.90 - 0.75
Reef cod	300/500-500/Up	0.70 - 0.80
Horse Mackerel	4/6	0.55
Silver Croaker	50/100- 300/Up	0.40 - 0.80
MIDDLE EAST AND OTHERS		
a) Middle East		
Red Snapper	300/500 - 700/1000	1.0
Silver Pomfret	100/200 - 200/300	1.95 - 2.90
Squid whole	10/20 - 20/40	1.50 - 1.60
b) Poland		
PUD SHRIMP	300/500 - Broken	2.40 - 1.60
c) Australia		
PUD	U/20 - 60/80	4.50 - 2.50
PD	16/20 - 41/50	.60 - 5.00

*(**Source** : Prime of MPEDA)*

Vol. 21 No. 10 & 11 FISHING CHIMES JAN/FEB 2002

Gujarat Newsletter

From *K.R.Narayanan*

Scampi Hatchery in Gujarat

Gujarat State will soon have its first Scampi Hatchery at Umarwada (Ankleshwar Taluka) in Bharuch District.

Promoted under the Indo-French Financial Protocol (1997), the Project is to be established at a cost of Rs.560.50 lakhs, to be shared between the Government of Gujarat (47%) and the French Government (53%). The contribution from the French Government is in terms of equipment, technology input and training to the Hatchery Managers through the French Consultants, Cofrepeche. The Government of Gujarat, will meet the cost of the land, civil construction, installations for water and power and other inputs. The Hatchery is designed to produce 40 million nos of juveniles per annum.

The Apex Fisheries Co-operative of the State, viz., Gujarat Fisheries Central Co-operative Association Ltd. (GFCCA) has been appointed as the implementing agency for the project.

It is reported that there has been considerable escalation in the project cost (Rs.925.23 lakhs) of the hatchery. However the French contribution would remain confined to their share in the original project cost.

Presently, the Narmada estuary in Bharuch District yields about 250 lakhs (25 million) nos of wild Scampi seed per year. The seed is in great demand for polyculture of Scampi along with major carps in the south Gujarat region. It is also reported that the hatcheries of Kerala, Karnataka and Andhra supplement the present Scampi seed requirements of the State.

It is hoped that the new Scampi Hatchery at Umarwada will be commissioned in early 2002 and it would ease the Scampi seed availability in the State to a great extent.

New Fillip to Inland Fisheries in Gujarat

In a meeting of the Fish Farmers Development Agencies of the South and Central Gujarat region held at Kevadia (Narmada) on 8th November, 2001, the Fisheries Commissioner of Gujarat State, Mr.P.K.Parmar has highlighted that the upcoming Sardar Sarovar Project and its command area affords scope for promoting capture and culture fisheries through providing training to the fishermen and the people affected by the project.

The Sardar Sarovar reservoir has an area of about 3,500 ha. The Sardar Sarovar Narmada Nigam Ltd. (SSNNL) and the Department of Fisheries have been engaged in developing fisheries of the reservoir from 1990 onwards. It is estimated that about 380 lakhs of major carp seed have been stocked so far in the reservoir and the Dyke Ponds. Of late, the SSNNL is stocking large sized (100 mm. in length) fingerlings of Catla and Rohu from the seed farms of the Department of Fisheries and the Gujarat Fisheries Central Co-operative Association Ltd.

The command area of the reservoir will cover many seasonal and perennial tanks for culture fishery development. Ponds in the command area would also be benefitted as part of the fishery development programme of reservoir and ponds around.

The Commissioner of Fisheries, therefore, urged the District Fisheries officers and the FFDAs to initiate selection of persons to be trained, provide training and later induct them into fisheries activities, while simultaneously identifying the water sheets suitable fo fisheries development by them.

Fish Seed Production in Gujarat

It is reported that the State Fisheries Department of Gujarat produced 49.65 crore nos of spawn during the monsoon of 2001 at its seeds farms at Ukai, Kosmada and Pipodra (Surat District) and Palan (Valsad District). This does not include 7.50 crore nos of spawn produced by the Gujarat Fisheries Central Co-operative Association Ltd. at its seed farms at Valod and Wankaner (Surat District).

The State has been experiencing acute drought and water scarcity during the last three years and hence the farms situated in the southern districts of Surat and Valsad only have been pressed into production and the farms in the districts of Panchmahals, Dahod, Vadodara, Kheda, Anand, Sabarkantha and Banaskantha were utilized only for seed rearing purposes.

VISION - 2010 of Gujarat Fisheries Department

Mr.P.K. Parmar, Commissioner of Fisheries, Gujarat State, has drawn up a Vision 2010 plan, basing on the past experiences of the State to streamline and intensify the fisheries development programme for Gujarat.

An officer of the 1985 batch of the Indian Administrative Service and an MBA from the Ljubljana University, Slovenia, Parmar took over charge as the Commissioner of Fisheries in February, 2001, when the State was in a great trauma generated by the terrible earthquake of the 26th January, 2001. He was involved in the rehabilitation programme of earthquake affected persons in Kachchh district.

The development programmes contemplated for the next decade aim at:

- Expansion of the facilities in the existing fishing harbours
- Establishment of new fishing harbours
- Marine resource building through Sea Ranching
- Development of mariculture
- Freshwater aquaculture promotion and establishment of hatcheries for Scampi and finfish
- Inland fisheries development with reference to Sardar Sarovar Project.

There has been a major expansion of the fishing fleet of the State and this has resulted in great congestion in the existing fishing harbours of Veraval, Mangrol and Porbandar. The Commissioner of Fisheries feels that these fishing harbours need to be expanded and improved in order to meet the requirement of the growing fishing fleet. The problems faced by the Gujarat fishermen at the Bhav-cha-Dhakka (New Ferry Wharf) in Mumbai and overcrowding in the existing harbours has necessitated the establishment of new fishing harbours at Dholai, Jakhao, Okha and Umbergaon on priority basis.

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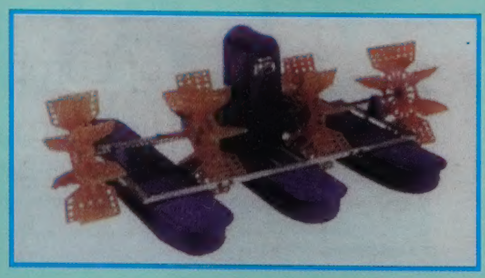

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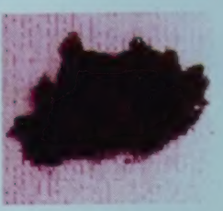

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